MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

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CONTENTS

	Page
Ninety Lubrication Points—One Pump! *By Fred M. Hewitt*	19
Scanning the Field for Ideas	23
Avoid Waste of Material in Parts Design! *By V. L. Maleev*	26
Light Alloy Improved by Cerium	29
Greatest Machine Show Ushers in New Era *By Harold B. Veith*	30
Roller Bearings Take Shock of Rock Crushing *By A. L. Munro*	32
Helium Gas Replaces Mechanical Device *By E. W. Weaver*	35
Don't Overlook Surge in Designing Springs *By C. H. Kent*	37
Self Contained for Interchangeability	40
New Machines Indicate Design Trends	41
Design Features in New Machines	42
Quest for Good Designers Indicates Greater Design Activity (Editorial)	44

Professional Viewpoints	45	New Materials and Parts	54
Men of Machines	47	Manufacturers Publications	77
Noteworthy Patents	49	Business Announcements	79
How Is Business?	51	Cross Sections	81
Topics	52	Calendar of Meetings	16

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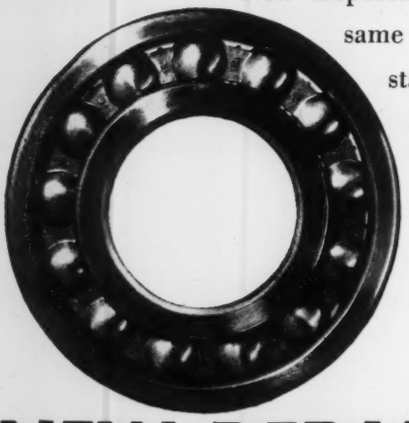

Nothing Rolls Like a Ball

NEW DEPARTURE BALL BEARINGS

Itemized Index

CLASSIFIED FOR CONVENIENCE WHEN STUDYING SPECIFIC DESIGN PROBLEMS

Design Calculations:

Pivoted motor bases, Edit. 45, 46
Spring fatigue, Edit. 37, 38, 39L
Stresses, Edit. 26, 27, 28, 76R

Design Problems:

Feed, controlling by weight, Edit. 23
Helium, replacing mechanism with, Edit. 35, 36
Interchangeability, insuring, Edit. 40
Light alloy, selecting, Edit. 29
Lubricant, applying efficiently, Edit. 19, 20, 21, 22
Materials, utilizing full efficiency of, Edit. 26, 27, 28, 76R
Out-of-balance, obviating, Edit. 24R, 25L
Quietness, securing, Edit. 31L
Roller bearings, applying, Edit. 32, 33L
Springs, reducing failures of, Edit. 37, 38, 39L

Finishes:

Machine, testing fineness of, Edit. 72R

Materials:

Alloys (Iron), Edit. 31R
Alloys (Nickel), Edit. 24, 29, 31R; Adv. 65
Alloys (Steel), Edit. 33, 58R, 60R; Adv. 73
Aluminum, Edit. 29, 52R
Brass, Edit. 39L
Copper, Edit. 21
Felt, Edit. 22R; Adv. 80L
Fibre, Adv. 72L
Graphitic-carbon, Edit. 23R, 24L
Molybdenum, Adv. 69
Plastics, Edit. 66R, 68R; Adv. 70L
Rubber, Edit. 24R, 25L
Zinc, Edit. 33L

Mechanisms:

Eccentric, Edit. 32, 33
Feeding, Edit. 50R
Forming, Edit. 50
Sealing, Edit. 49, 50L

Organization and Equipment:

Engineering department, Adv. 57, 74L, 76L

Parts:

Bases, Edit. 45, 46
Bearings, Edit. 21R, 24R, 25L, 32, 33, 40R, 56R, 58R; Adv. 6, 53, 55, 75R, 84
Cast parts, Edit. 31R, 33
Clutches, Adv. 70L
Controllers, Edit. 64R, 66R, 70R, 72R
Controls (Electrical), Edit. 39, 54R, 56R, 58R, 60R, 62R, 64R, 68R; Adv. 2, 83
Couplings, Edit. 62R
Drives, Edit. 30R, 31L, 33, 46R, 54L, 76R; Adv. 9, 13, 17, 59, 71, 77
Electrical accessories, Adv. 11
Fastenings, Edit. 60R
Gears, Edit. 30R; Adv. 14, 63
Hydraulic equipment, Edit. 30R, 40, 66R
Instruments, Edit. 68R, 70R
Lubrication and lubricating equipment, Edit. 19, 20, 21, 22, 31, 33R, 34L; Adv. 61, 79
Motors, Adv. 10, 15, 58L, 62L, 64L, 68L, 82
Packing glands and packing, Edit. 22, 34L; Adv. 4, 60L, 67, 72L
Pneumatic equipment, Adv. 3
Pumps, Edit. 33, 40; Adv. 68L, 74L, 80L
Shapes, Adv. 56L
Shims, Adv. 76L
Springs, Edit. 34; Adv. 12
Tubing, Edit. 21, 54R, 56R; Adv. 18
Welded parts and equipment, Edit. 24, 39L, 52R, 54; Adv. 8

Production:

Selecting machines for, Edit. 30, 31, 74R
Welding copper alloys, Edit. 39L

Key: Edit., Editorial Pages; Adv., Advertising Pages; R, Right hand column; L, Left hand column

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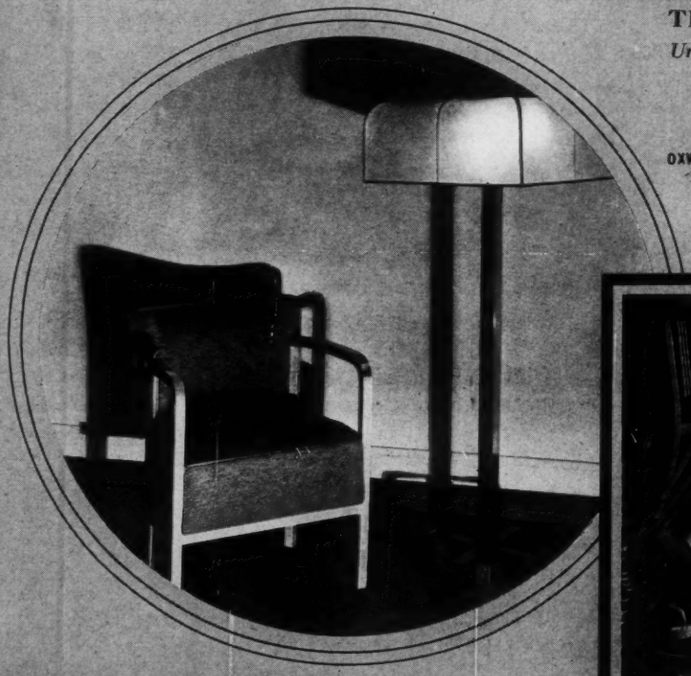

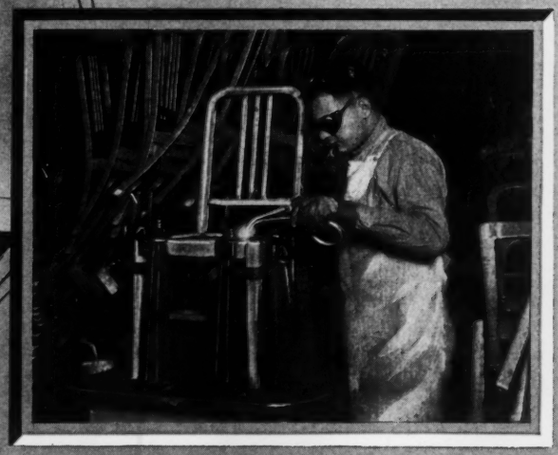

QUIETNESS . . . LIGHT WEIGHT . . . CONSTANT SPEED

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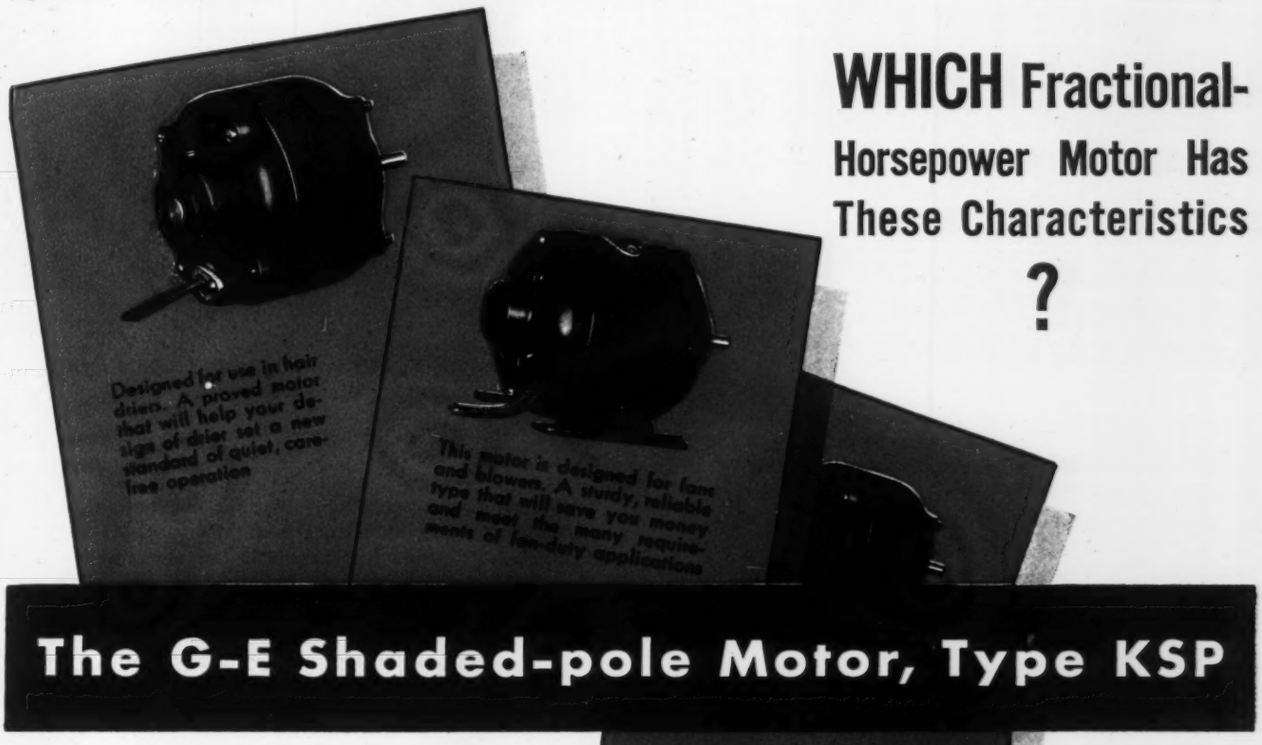
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070-99

GENERAL ELECTRIC

Calendar of MEETINGS and EXPOSITIONS

TECHNICAL interest in October will be focussed on one of the most important elements of machinery—gears and transmissions—by the annual Gear Manufacturers' meeting at Niagara Falls * * * * Papers will include . . . a discussion of gear lubrication by T. C. Dick . . . . J. O. Almen will present data on gear tooth wear or the strength of gears from the transmission standpoint . . . . speed increasing gears and gear units and their technical differences from reducing gears and gear units will be the subject of P. C. Day . . . . and a metallurgical analysis of gear failures as seen through the microscope will be presented by John T. Howat * * * This annual meeting regularly supplies outstanding studies on gears and transmissions . . . . members of the association are technical leaders in the field.

Following the excellent lead of the Machine Tool and National Metal Congress, October will present more specialized displays of equipment * * * Business machines, rapidly becoming among the most complicated of machinery, will be on display in New York . . . . power equipment and parts are scheduled for exhibition at Chicago . . . . Atlantic City will be host to the Gas association and the exhibition of equipment for this industry . . . . Safety will be the keynote of the exhibit held in conjunction with the Safety council in Louisville * * * Just after the first of November, the one exhibit which attracts the universal attention of engineer and layman will open in New York . . . . the New York automobile show, moved up from January, will present the latest results of the design ingenuity annually displayed by automotive engineers.

Oct. 14-15—

American Gear Manufacturers' association. Eighteenth semiannual meeting will be held at The General Brock hotel, Niagara Falls, Canada. J. M. McQuiston, Penn Lincoln hotel, Wilkinsburg, Pa., is manager-secretary.

Oct. 14-19—

National Business Show. Exhibition of machines and equipment to be held at Commerce Hall, Port Authority building, New York. Frank E. Tupper, 50 Church street, New York, is secretary of the exposition.

Oct. 14-18—

Midwest Power Show. Seventh exhibition to be held at Chicago. G. E. Pfisterer, 1 North LaSalle street, Chicago, is managing director.

Oct. 14-18—

American Gas association. Annual convention and exhibition to be held at the Auditorium, Atlantic City, N. J. Kurwin R. Boyes, 420 Lexington avenue, New York, is secretary.

Oct. 14-18—

National Safety council. Annual meeting and exhibition of equipment to be held at Brown and Seelbach hotels, Louisville, Ky. W. H. Cameron, 20 North Wacker drive, Chicago, is secretary and managing director of the council.

Oct. 16-18—

American Institute of Steel Construction Inc. Thirteenth annual meeting to be held at Greenbrier hotel, White Sulphur Springs, W. Va. V. G. Iden, 200 Madison avenue, New York, is acting secretary.

Nov. 2-9—

New York Automobile Show. Annual showing of new models will be held in New York City.

Nov. 12-15—

International Acetylene association. Thirty-sixth annual meeting to be held at Cleveland hotel, Cleveland. H. F. Reinhard, 30 East Forty-second street, New York, is secretary.

Dec. 2-7—

Exposition of Chemical Industries. Fifteenth exhibition to include new machines will be held at Grand Central Palace, New York. Charles F. Roth, Grand Central Palace, New York, is manager.

Jan. 27-31—

International Heating and Ventilating Exposition. Fourth exhibition to be held at International Amphitheatre, Chicago. Information may be obtained by addressing the Exposition at Grand Central Palace, New York.

MACHINE DESIGN

Ninety Lubrication Points— One Pump!

By Fred M. Hewitt

PRONOUNCED improvement has been made in the designing of all types of machinery within recent years, in the direction of making them more nearly automatic in operation and maintenance. Yet there has been a distinct lag in at least one common feature—the method of applying lubricant. However, the progress made by manufacturers recently in displacing laborious and uncertain point-by-point hand lubrication with automatic or semiautomatic systems gives promise that a long-needed evolution in lubricating methods is about to become general.

An interesting case is that of a leading manufacturer of accounting machines who solved a relatively difficult lubrication problem in a simple and positive way. This case, discussed in the following, is of particular interest because office employes, such as those operating accounting machines are not required to possess mechanical knowledge. Neither does the routine in a busy office allow for time to be spent in the maintenance of machinery. Yet office workers daily

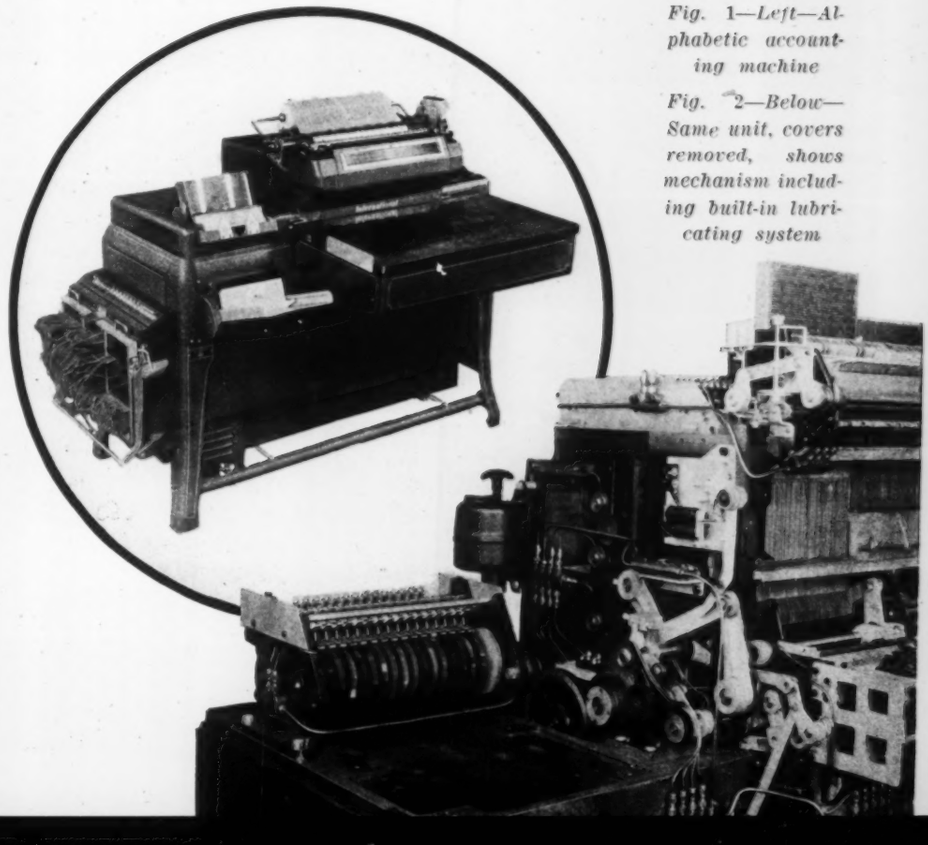


Fig. 1—Left—Alphabetic accounting machine

Fig. 2—Below—Same unit, covers removed, shows mechanism including built-in lubricating system

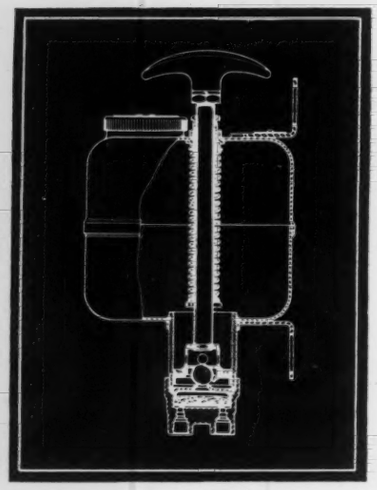


Fig. 3 — Sectional view of lubricator. A small piston pump is operated by a tee handle at the top of the reservoir. Coil spring forces piston downward to feed oil into system

use machinery that is as intricate as any employed in industrial plants where the operators are more familiar with the functioning of mechanisms.

Designers of these accounting machines, bearing in mind the non-mechanical training of their users, have shown ingenuity in reducing the necessity for maintenance operations to a minimum. Ordinarily the most important maintenance item for office machines is lubrication of the moving parts. Although the development of equipment of this kind has progressed to a point where failures in service are comparatively rare, on the few occasions when trouble does occur it may usually be traced to inadequate lubrication.

Oil Preferred As Lubricant

Quick-moving machine parts constantly require a film of lubricant between adjacent metal surfaces to prevent undue wear and to insure free and positive action. Bearing clearances are close and synchronization among the moving parts finely adjusted. Therefore, the perfect operation of office machines makes it necessary to prevent sluggishness or sticking of any part and this can only be insured by providing lubrication that is continuously adequate. Because of its better penetration and ease of application, oil is preferred to grease for lubricating such equipment.

Although the nature of the lubricant is of extreme importance in the successful upkeep of office machines, the method of application of the lubricant requires even more consideration. The best lubricant is worthless if it does not succeed in reaching the bearing surfaces. If it be necessary to oil each of the many bearings one at a time, as in the case of point-by-point lubrication by hand, there is likely to be neglect of some of the bearings from time to time. Possibility of freeze-ups due to dry bearings is far from remote in machinery so lubricated. A freeze-up may cause the twisting, bending or shearing of some part, entailing a difficult and costly repair job.

In the latest models of electric accounting machines of International Business Machines Corp., the mere raising of a tee handle of a lubricator provides the impulse that oils all of the bearings simultaneously. This handle is readily reached by raising a hinged cover. Entire operation of lubricating the machine requires only a few seconds.

Automaticity Features Design

One of the important types of equipment in this line of machines, the alphabetic accounting machine, *Figs.* 1 and 2, is employed for the automatic handling of accounting and statistical data. The process of operation comprises the use of tabulating cards and the electrical equipment which handles the cards in progressive stages until final results have been achieved. These tabulating cards constitute the basis of the method and on them all information is recorded in the form of punched holes, representing all data pertinent to a given subject.

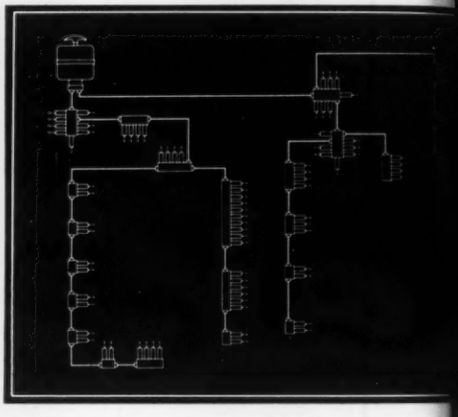


Fig. 4 — Alongside — Schematic diagram showing location of junctions and other parts of lubrication system

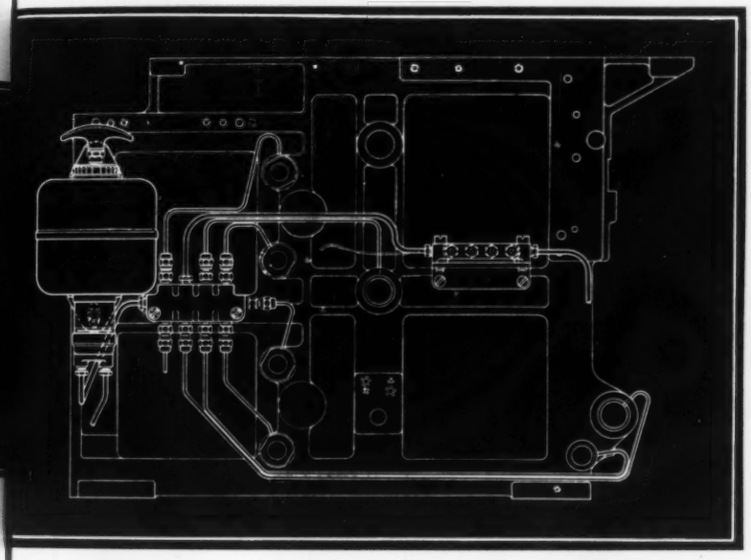
Fig. 5—Extreme Right —Detail of frame assembly of accounting machine in which typical junction with tail tubes leading to several bearings can be seen

Value of these electric accounting machines lies in their phenomenal speed, their flexibility in handling accounting and statistical data, their accuracy, and tneir ability to accomplisn results at much less cost than that entailed when identical work is manually performed. Some idea of the highly intricate mechanism of alphabetic accounting machines may be gained from the fact that each one contains 50,000 separate pieces consisting of 2400 different parts and has 75 miles of wire connections.

Alphabetic accounting machines are not sold but rented to their users. It has been the constant aim of the manufacturer to make this equipment as trouble-free and as durable as possible. The little maintenance required is taken care of by the manufacturer, through a corps of trained servicemen who visit at regu-

lar intervals the offices where these machines are in operation. Before the new type of lubrication was adopted it was necessary for the serviceman to take care of the lubrication of the machine during his periodic visits, there being so many bearings and some in such isolated locations that the task of reaching each one by hand with an ordinary oilcan was considered much too involved for the user of the machine. The procedure was to strip the mechanism by removing several metal covers, thus exposing the bearings which had to be lubricated one at a time. The amount of time consumed in this routine was considerable.

With the new lubricator, *Fig.* 3, it is only necessary to raise a small hinged cover and pull the tee handle of the lubricator once. This sends oil to all bearings simultaneously, regardless of their relative distances from the central reservoir. Lubrication of the entire machine thus becomes a matter of a few seconds. As every bearing is on a line of metal tubing leading directly from the lubricator, it is impossible to overlook or forget a bearing.



Analysis of Lubricating System

The Bijur lubricating system used in these accounting machines consists of several essential parts: A small metal reservoir; two oil feed lines of 5/32-inch copper tubing; twenty-three junctions connected in two series to the reservoir by means of the two oil feed lines; oil metering fittings or, as they are more commonly called, "drip plugs", at the junctions, each controlling the amount of oil fed to one bearing; tail tubes of 3/32-inch O. D. copper tubing, each one leading from a drip plug to a bearing, *Fig.* 5.

In all, this system with a single reservoir reaches and serves ninety bearings. The schematic diagram shown in *Fig.* 4 gives some idea of the arrangement of the component parts of the lubricating system. The reservoir, *Fig.* 3, contains a small piston pump operated by means of a tee handle at the top of the reservoir. In the normal position the pump piston is held down by the operating spring and the pump outlet is mechanically closed. When the tee handle is pulled the piston is raised, compressing the coil spring and drawing oil through the hollow piston and ball check valve into the pump cylinder in the space under the piston. The piston fit in the cylinder is sealed with a cup leather.

As the tee handle is released, the coil spring forces the piston downward and the upward rush of oil lifts the valve ball to its seat in the piston. The measured charge of oil trapped in the cylinder below the piston is then automatically forced through the felt filter into the oil feed lines by the pressure of the spring. Stroke of the piston is adjustable so that any predetermined amount of oil may be fed into the lines at each operation of the pump.

Oil Control to Bearings

Metering fittings or "drip plugs", *Fig.* 6, form an important part of the lubricating system. Each bearing has its own drip plug and this device controls the amount of oil fed to that particular bearing. The pump, therefore, measures the total quantity of oil fed into the system and the drip plugs proportion this quantity according to the requirements of each bear-

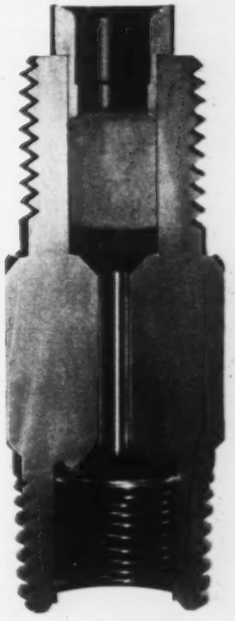


Fig. 6 — Metering fitting or "drip plug." Each bearing has one of these devices which controls the amount of oil fed to that particular bearing. As the quantity of oil required by some bearings is greater than that of others, larger flow rate fittings are employed for the larger bearings

ing. As the amount of oil required by some bearings is greater than that required by others, larger flow rate drip plugs are used for the larger bearings.

Drip plugs accomplish their metering task without the use of any moving parts, thereby eliminating wear and assuring uniformity of flow rate indefinitely. They are self-contained, non-adjustable units. Each drip plug contains three elements: A felt filter, a restriction pas-

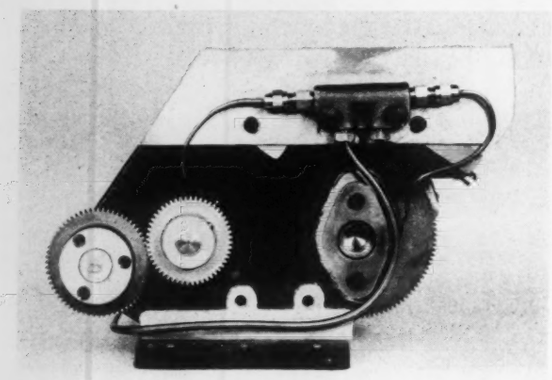


Fig. 7—Circuit breaker contact assembly of the accounting machine shows method of attaching the junction, metering plugs and tubing of the lubricator

sage containing a pin, and a check valve (see *Fig.* 6). The restriction pin nearly fills the cylindrical passage in which it lies. Clearance between the pin and the passage wall determines the rate of oil flow. These drip plugs offer such a high resistance to oil flow that they are the controlling factor in oil distribution and there is practically no variation in oil delivery due to flow resistance in the tubing.

Check valves in the drip plugs maintain the entire tubing system full of oil between pump operations so that immediately the pump is again operated, pressure develops and oil is instantly fed to the bearings. As the tail tubes leading from the drip plugs to the bearings are too small in diameter (3/32-inch) to permit an air bubble to pass through the oil, these tail tubes are also kept full of oil between pump operations. The check valve is normally held closed by a spring, but opens under a pressure of approximately five pounds per square inch, allowing oil to flow. When flow ceases, the pressure drops to five pounds per square inch and the valve closes, keeping the lines full of oil and preventing drip. The valve is faced with a flexible oilproof material which permits a positive seal against leakage.

Two sizes of drip plugs are used on the alphabetic accounting machine, Nos. 0 and 1. The former delivers 1½ drops, the latter 3 drops at each operation of the pump. As the prescribed lubricating routine calls for operating the pump once a week and the average number of hours such machines are operated weekly seems to be about forty, the hourly feed of oil amounts to .001 c.c. for the No. 0 drip plug and .002 c.c. for the No. 1 drip plug.

In a "closed" lubricating system of the type described here, the oil is fed to the bearings in the form of a heavy film. The feed, therefore, does not have to wait until a full drop forms. This is a decided advantage where low rates of feed are required as a small fraction of a drop will find its way to the bearing as readily as a full drop.

Another feature of such a "closed" system is its cleanliness, as it is impossible for dirt to be fed into the bearing with the lubricant. Before entering the oil feed lines the lubricant is filtered through heavy felt. Again is passes through a felt filter as it leaves the drip plug before it reaches the bearing. As the tail tubes are inserted well into the oil holes at the bearings, there is no tendency for oil to gather on the surface and collect particles of dirt.

The lubricator serves horizontal and vertical bearings from ½ to 1-inch diameter, at speeds varying from 40 to 150 revolutions per minute. Most are steel shafts on bronze and a few are steel on steel. The system is unusually complete, even lubricating two needle bearings in the zone drive unit of the machine.

Principles of lubrication outlined here are adaptable to all kinds of machinery. Available to the machine manufacturer is a variety of lubricators from which to select, either semi-automatic or automatic, the latter being mechanically driven and particularly constructed to meet conditions requiring frequent or continuous feed.

Build Lubricator Into Machine!

Built-in lubrication of the type discussed is becoming recognized as essential equipment on a wide variety of machines. Hit-or-miss oiling of bearings is gradually being eliminated, due to the progress being made by machine manufacturers in designing into their products proper equipment to lubricate all bearing surfaces effectively. Such foresight on the part of the machine designer produces definite results.

Twenty million miles of thread, spun from fleece sheared from four million Angora goats will be woven into mohair material during 1935 to supply Chevrolets with fifteen square yards of upholstering apiece. The cloth is only half the thickness of the material as it is woven. Coming from the loom double, the two layers of cloth are cut by a machine incorporating a knife of razor sharpness to form two pile surfaces.

Scanning the Field . . . FOR IDEAS

FEED CONTROL BY WEIGHT

SOME of the most effective mechanisms are based on ideas which are impressive in their simplicity. From the beginning of mechanical science the lever and fulcrum have played an important part in the development of machinery. The balance scale is a good example. By sliding a known weight or counterbalance on a scale beam an object of unknown quantity is weighed. Now the principle, in a slightly different way, is utilized to operate a regulating feeder for feeding dry or damp, coarse or fine materials.

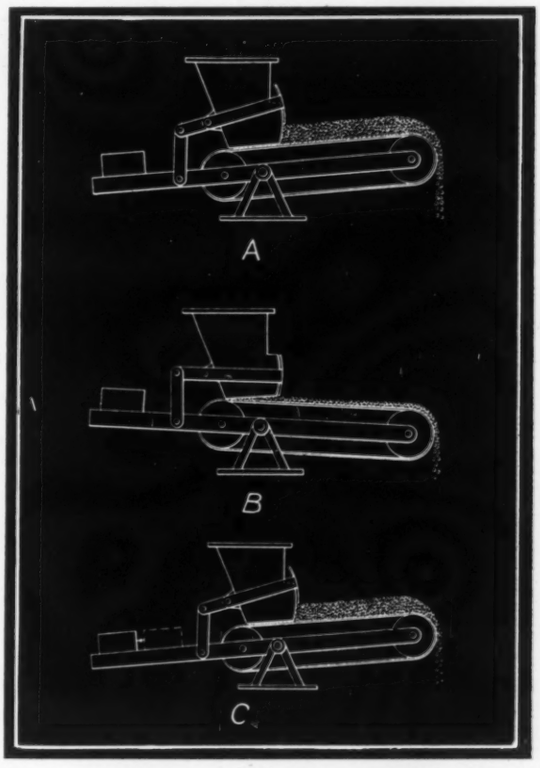


Fig. 1—Variation in weight of material tilts pivoted frame to regulate feeding device

In the Hardinge device, the principle of which is illustrated in *Fig.* 1, a traveling belt on a pivoted frame is employed. This belt is suspended below the feed hopper so that any variation in the weight of the material on the belt will tilt the frame. In other words, when the material is lighter than that for which the counterweight is set, the frame will tilt up and connecting links will cause the gate to open wider, thus increasing the volume of material (sketch A).

If the material delivered to the belt becomes too heavy due to atmospheric conditions, etc., the belt will tilt down, partly closing the gate and reducing the volume (sketch *B*). By moving the counterweight back a new position is set for the belt, and the feeder automatically will correct itself to a new capacity setting and continuously feed at the new rate (sketch *C*).

PREVENTING METALLIC CONTACT

GRAPHITIC-CARBON supporting rings to prevent metallic contact of the piston with the cylinder bore of a compressor is an idea that solves a problem involving the compression of air or gas which must not be contaminated by oil or other lubricant. Pressure rings, also of carbon, are segmental with metallic inner expanding rings to provide the proper wall pressure.

Because of the elimination of metallic friction and the self-lubricating qualities of the carbon, the cylinder of this new Ingersoll-Rand compressor requires no oil, grease, water, glycerine or other lubricant. Thus the compressed air or

gas does not come into contact with any lubricant except possibly a minute amount of crankcase oil that might conceivably creep along the piston rod into the cylinder. Every precaution in design, however, is taken to keep crankcase oil out of the cylinder. To prevent rusting of the cylinder passages due to lack of oil lubrication, all inside walls except the bore are coated with heat-resisting paint.

METAL RADIO TUBE UTILIZES WELDING

BEHIND the development of the new General Electric all-metal radio tube, *Fig.* 2, lie several interesting ideas. One is the use of Fernico, a combination of iron, nickel and cobalt with about the same coefficient of expansion as glass. This alloy is employed for the eyelet. Each lead-in wire passes through a small bead of special glass that is fused securely within the eyelet which in turn is welded to the metal container.

And speaking of welding brings attention to another important phase in the manufacture of these tubes. Thomson-Gibb engineers had a hand in working out the resistance welding procedure. Without this type of welding it is doubtful whether the all-metal radio tube would be practical from either a mechanical or production standpoint. It takes the precise control of welding variables provided by a modern welding press to handle the special alloy eyelet seals, the vacuum tight projection weld of the shell to the header and the "welding-off" of the exhaust tube.

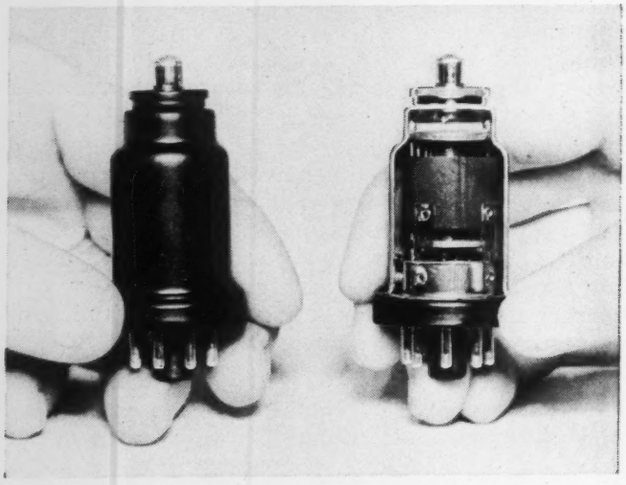


Fig. 2—*Resistance welding and cobalt-nickel-iron alloy play important part in metal radio tube development. The alloy has substantially the same coefficient of expansion as glass*

The new small tubes offer improved electrical characteristics, provide their own shielding through the steel shell, and are better heat conductors and radiators than glass tubes. Elimination of the glass "pinch seal," in which all leads and supports are concentrated in the glass tubes, allows the leads to enter the header of the new tube at the proper points for short, direct paths. Also, the new design permits a logical arrangement of connections and supports between base pins and electrode structure.

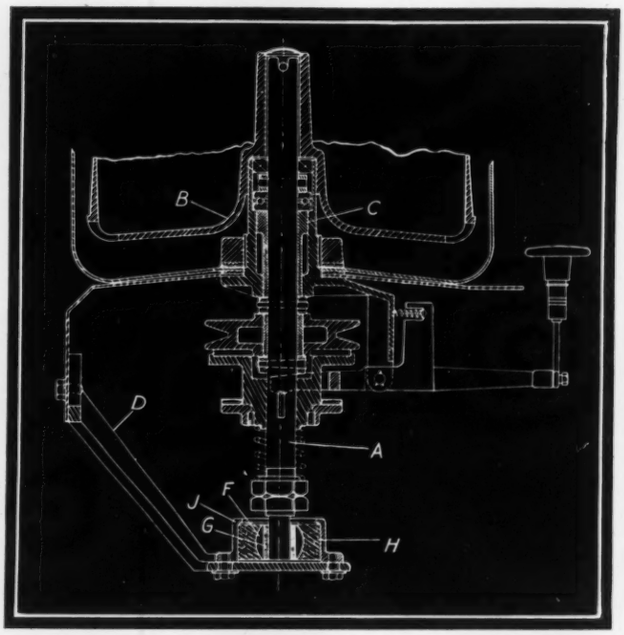


Fig. 3—*Oilless type bearing mounted in rubber dampens vibration and permits misalignment of spinner shaft*

RUBBER FOR BEARING MOUNTING

IN SPINNERS or centrifugal dryers of washing machines difficulty often is encountered because of the fact that clothes crowded in one side of the basket set up an out-of-balance condition, causing noise and vibration to result. To permit misalignment of the spinner shaft caused by whip, and also to dampen vibration, the lower bearing in the Prima washer has been mounted in rubber, *Fig.* 3.

Spinner shaft *A* operates at a speed of 800 revolutions per minute, carrying basket *B*. This shaft previously was held only by the oilless sleeve bearing *C*. Off balance set up when whipping occurred caused bell mouthing of bearing *C*. The bearing *G* employed to obviate this condition is located at the lower end of bracket *D*. It is of the oilless type pressed into a ball-shaped retainer *F*, which in turn is housed in a molded rubber ring *H*. The entire assembly is pressed into the cap *J* bolted to bracket *D* in such a manner that clearance is provided to permit movement a sixteenth of an inch in any direction, before the bolts are tightened. The ball-

shaped bearing retainer moves in the rubber to correct misalignment should whipping occur.

CAMERA FINDS SOURCE OF TROUBLE

WHAT designers have been doing toward improving the operation of machines through studies made of operating characteristics by use of the motion picture camera has been discussed in this department in the past. Possibilities of this type of design research are unlimited and as new applications come to light they will be discussed. One that proves interesting is the investigation of truck oscillation or "nosing" on rail cars.

As shown in *Fig.* 4, a slow motion 16 mm. Bell & Howell motion picture camera was mounted in a box on the bracket on one corner of a truck

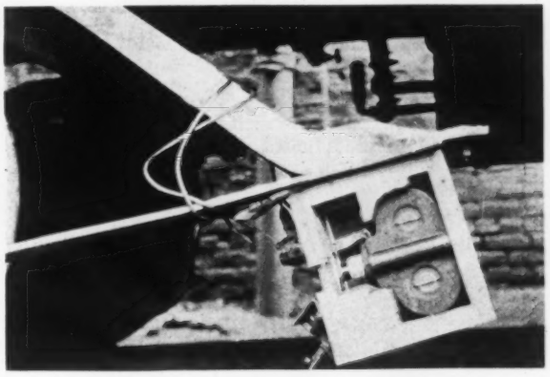


Fig. 4—Faulty design can be detected by using the motion picture camera to secure "shots" of a mechanism as it functions in service

that was guilty of nosing. The device was focused on the lower part of the wheel where it contacts the rail, and pictures taken of a worn wheel as found in service, and then of a new replacement wheel. The only difference noticeable in the movies was the less violent action of the new wheel due to the fact that this wheel had less clearance between the flange and rail than did the worn one. This led to the belief that the oscillation was caused by the taper of one inch in twenty which has been part of the standard design for railroad wheels.

On this belief, a set of wheels was turned without any taper but with the flange kept the same shape and size as formerly. Slow motion pictures of these wheels showed no oscillation at all; in fact the flange seldom impinged upon the rail on a straight track. Riding of the car was improved greatly and there was no more nosing.

RAILROAD PIONEERS ANOTHER IDEA

COULD better evidence of an awakening be found than that exemplified by the railroads in the past few years? What they have accomplished should be an inspiration to any designer with a discouraged outlook. Take the new diesel locomotive, the Chief, which Santa Fe recently put into service. In appearance the new development, *Fig.* 5, is unique in that it does not follow the extreme "streamlined" appearance of some of its clan. Actually, it is a multiple unit of two identical sections, which can be operated singly or together.

A pleasing effect has been obtained by modification in the steel jackets that hide every detail of engineering apparatus; by the molding and slope of the rather blunt ends; the flowing steel skirts with removable sections, that cover the wheels and underbody. An attractive color scheme in black, cobalt and sarasota blues, golden olive and pimpernel scarlet has been worked out.

The units are arranged for double-end operation, with an operator's cab and control station at each end. Motive power for each unit of the locomotive is supplied by two Winton V-type twelve-cylinder two-cycle oil engines. Among the new features developed especially for this modern type of locomotive is the steam generating unit for heating and air conditioning the cars of the train. Maximum safe speed of the new engine has been set at 98 miles per hour.

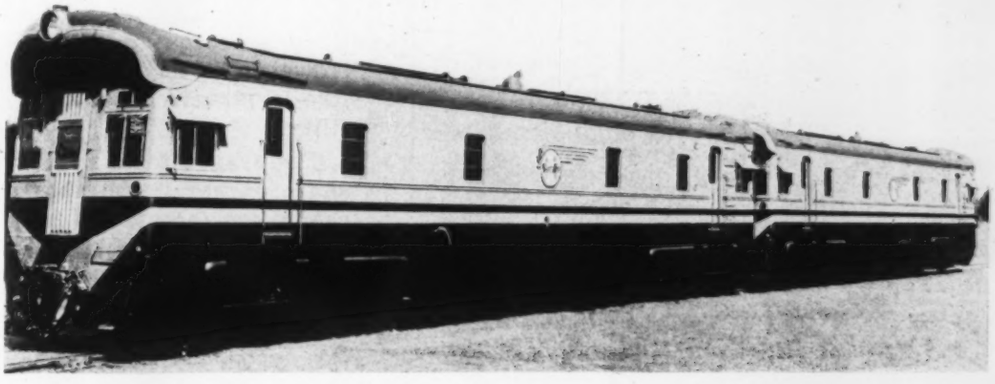


Fig. 5—Another idea in modern diesel locomotives, but less radical in streamline design than some other developments in this field. It is in effect two locomotives since it consists of two identical units

Avoid Waste of Material in

By V. L. Maleev

Professor of Mechanical Engineering, Oklahoma Agricultural and Mechanical College

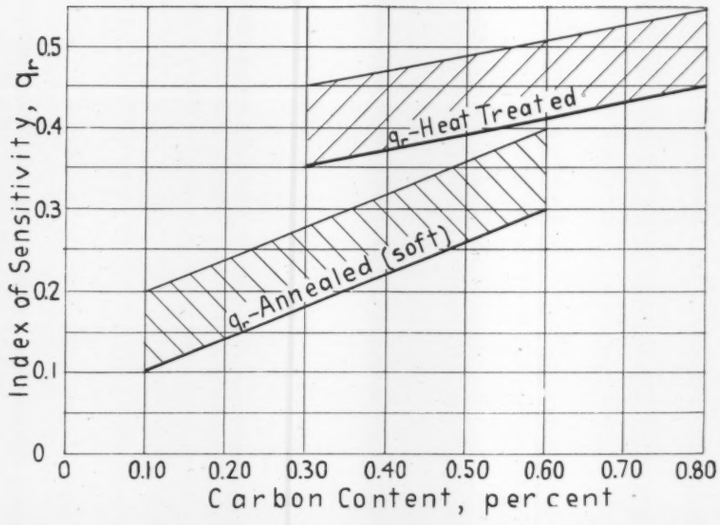


Fig. 24—Approximate maximum values and average values of sensitivity index for carbon steels are indicated by tests

ACCORDING to the present theory, a fatigue failure starts with a minute crack at the point of the highest stress concentration and this crack acts as a notch, increasing the stress concentration at this point and causing final failure. In the August issue of MACHINE DESIGN this ratio was called the stress concentration factor. Since it has a certain relation to the form factor k, introduced in June and July, but refers to repeated stress, the designation k_r will be used.

Fig. 23 illustrates the influence upon k_r of the actual size of the tested bars and shafts. *Fig.* 24 shows values of the sensitivity index for carbon steels compiled from published tests. The heavier, lower lines refer to average values, while the upper lines represent approximately maximum values as found by various experimenters. Finally, TABLE II, compiled from the same sources gives data for a wider range of materials. These data should be considered only as a first approximation, the possible discrepancies being about ± 10 per cent. For this reason it was useless to segregate the influence of different types of discontinuity, transverse hole, groove, or fillet, or the type of load. TABLE II shows that for various material and discontinuities q_r varies from zero up to 0.70. The index is smaller for ductile materials and increases if the ductility is decreased, such as by a heat treatment. However, Armco iron seems to be rather sensitive to stress concentration, in spite of its ductility.

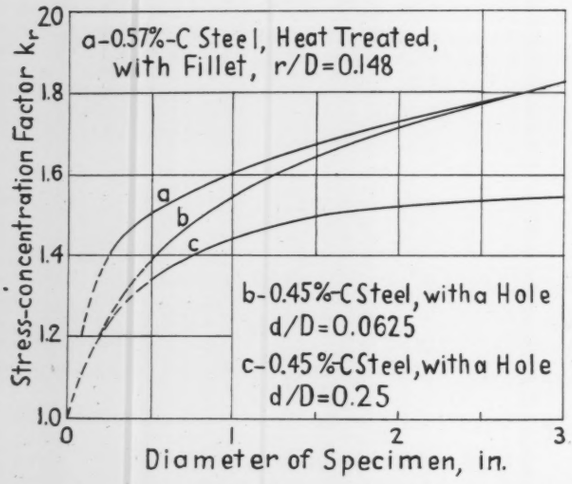


Fig. 23—Chart indicates the influence of size upon the stress concentration factor

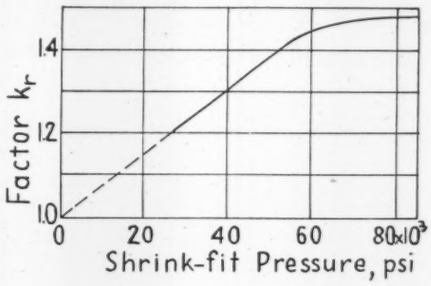


Fig. 25—Stress concentration factor due to shrink fit pressure

Endurance tests with *keyways* cut with very sharp corners have shown that the stress concentration factors are not high; for ductile steel $k_r=1.14$ and for relatively hard steel $k_r=1.27$[21]. The width of the keyway seemingly does not affect k_r.

Other tests have shown that sled-runner key-

[21]Seely, *Adv. Mech.*, p. 229.

Parts Design!

Fourth of a Four-Part Series

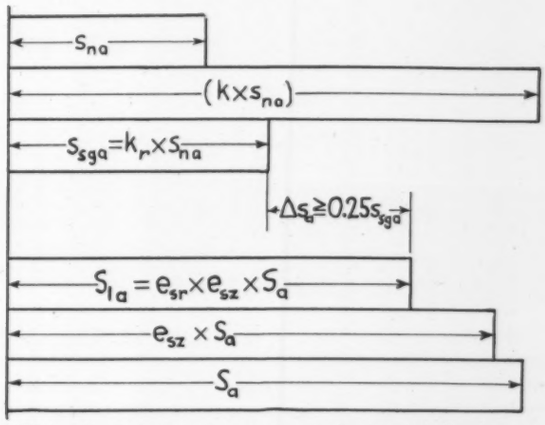


Fig. 26—Relation between stress amplitudes in a machine part subjected to repeated stress

TABLE II

Index of Sensitivity for Repeated Stresses

Material	Average Index of Sensitivity		
	Annealed or soft	Heat Treated and Drawn at 1200° Fahr.	Heat Treated and Drawn at 900° Fahr.
Armco iron, 0.02% C	0.30–0.40	.....	.....
Steel, 0.10% C	0.05–0.10	.....	.....
Steel, 0.20% C (also cast)	0.10	.....	.....
Steel, 0.30% C	0.18	0.35	0.45
Steel, 0.50% C	0.26	0.40	0.50
Steel, 0.85% C	.....	0.45	0.57
Spring steel, 0.56%C; 2.3 Si; rolled	.....	0.38	.....
Cr-Ni steel, 0.37 C; 0.6 Cr; 1.3 Ni	.....	0.45	.....
Cr-Ni steel, 0.8 Cr; 3.5 Ni	.....	0.25	0.70
Stainless steel, 0.3 C; 8.3 Cr; 19.7 Ni	0.16	.....	.....
Cast iron	0–0.05	.....	.....
Copper, electrolitic	0.07	.....	.....
Duraluminum	0.05–0.13	.....	.....

ways, cut with an ordinary milling cutter of the same width as the keyway, weaken the shaft less than profiled keyways cut with a cutter of the same diameter as the keyway width. In these tests failure occurred at the end of the keyway[22].

Press and shrink fits reduce the endurance limit considerably, *Fig.* 25. If a mild steel shaft is shrunk into a hardened bushing or hub, the stress concentrations factor k_r may become as high as 2.15. Especially detrimental is oxydation, rust appearing in the joints of highly stressed shrink fits. Its action increases gradually as the rust increases and must be prevented in a part subjected to repeated stresses.

Defines Significant Stresses

The nominal stress amplitude s_{na} multiplied by the stress concentration factor k_r gives the significant stress amplitude

$$s_{sga} = k_r s_{na} \quad \text{.....(33)}$$

Similarly the significant mean stress

$$s_{sga} = k_r s_{nm} \quad \text{.....(34)}$$

Actual safety factor is found according to the general definition

$$f' = e_{sz} e_{sr} S_a / k_r s_{na} \quad \text{.....(35)}$$

The relations between the various stress amplitudes which must be considered in a machine part subjected to repeated stresses can be illustrated by *Fig.* 26. The difference $\triangle S_a$ between the limit stress amplitude S_{la} and the significant stress amplitude s_{sga} expresses the *safety margin* and should not be less than 0.25 s_{sga} for aircraft design, and twice as much for all other cases.

Stress Load Relations

For the sake of simplicity, the case will be considered when the piece is subjected to repeated direct loads, tension and compression. If the maximum load is P_1, the minimum load is P_2, and the cross-sectional area is A, then the nominal stresses are

$$s_{n_1} = P_1/A; \; s_{n_2} = P_2/A \quad \text{.....(36)}$$

The nominal stress amplitude, by expressions

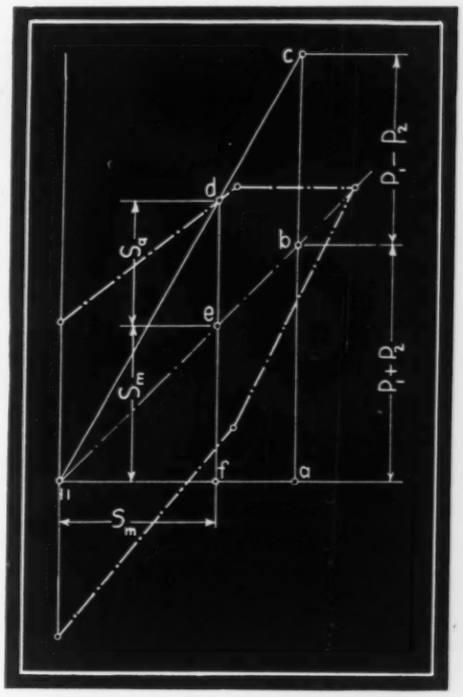


Fig. 27 — Auxiliary line on endurance diagram gives actual values of stresses

[22] Peterson, R. E., *Trans. A.S.M.E.*, 1933, APM-55-19, p.157 etc.

(25) (M. D., Aug., p. 24) and (36)

$$s_{na}=(s_{n_1}-s_{n_2})/2=(P_1-P_2)/2A \quad \text{.....(37)}$$

and the nominal mean stress

$$s_{nm}=(s_{n_1}+s_{n_2})/2=(P_1+P_2)/2A \quad \text{.....(38)}$$

The maximum, or significant stress amplitude, by expressions (33) and (37)

$$s_{sga}=k_r(P_1-P_2)/2A \quad \text{.....(39)}$$

The maximum value of the mean stress, or the

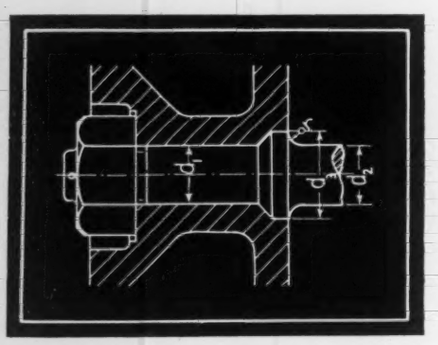


Fig. 28—With new approach to design it is possible to determine accurately the diameter of the piston rod end of a double-acting steam engine

significant mean stress

$$s_{sgm}=k_r(P_1+P_2)/2A \quad \text{.....(40)}$$

Equating s_{sga}, expression (39), to S_{da}, expression (29) (M. D., Aug., p. 29), gives

$$k_r(P_1-P_2)/2A=e_{sz}\times e_{sr}\times S_a/f \quad \text{.....(41)}$$

from which the endurance stress amplitude

$$S_a=fk_r(P_1-P_2)/2Ae_{sz}e_{sr} \quad \text{.....(42)}$$

Similarly it can be established that the maximum mean stress

$$S_m=fk_r(P_1+P_2)/2Ae_{sz}e_{sr} \quad \text{.....(43)}$$

and the ratio of the stress amplitude to the corresponding mean stress

$$S_a/S_m=(P_1-P_2)/(P_1+P_2) \quad \text{.....(44)}$$

The actual values of S_a and S_m can be found graphically from a given endurance diagram by drawing the auxiliary line *O-c, Fig.* 27; the line *d-f* drawn parallel to the axis of ordinates from the intersection of *O-c* with the endurance limit line at point *d* intersects the 45-degree line at point *e; d-e*$=S_a$ and *e-f*$=$*O-f*$=S_m$.

Simultaneous Action of Loads

The static load P' is simply added algebraically to the maximum and minimum loads P_1 and P_2. According to expressions (43) this changes the magnitude of S_m and according to the relations between S_m and S_a on the endurance diagrams, changes also the stress amplitude S_a and consequently the design stress amplitude S_{da}. The absolute influence of the static load depends upon the signs of P', P_1, and P_2 and may either increase or decrease the maximum stresses in the part.

EXAMPLE 4—Determine the diameter d_1 of the piston rod end of a double-acting steam engine, *Fig.* 28. The cylinder bore is 18 inches, the maximum steam pressure is 170 psig, the steam is exhausted to the atmosphere.

A suitable material is SAE 1045 steel, whose endurance diagram is given by *Fig.* 29.

Force acting on the full face of the piston is

$$P=0.7854\times 18^2\times 170=43{,}300 \text{ lb.}$$

On the crank side, due to the piston rod, the area will be about 1.5 per cent smaller, giving $P'=43{,}300\times 0.985=42{,}650$ pounds.

The stress set up by the tightening of the end nut may be asumed to be equal to one-half of that coming from the steam pressure. This corresponds to an additional load on this rod end $P''=21{,}300$ pounds.

Thus the minimum diameter at the root of the thread, with a static load, with $S_e=51{,}000$

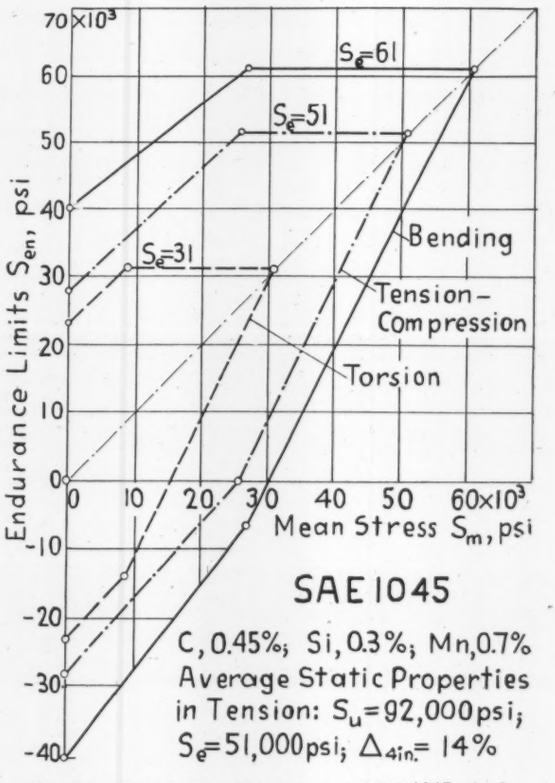


Fig. 29—Endurance diagram for SAE 1045 steel

pounds per square inch and a safety factor 2, must be

$$d=\sqrt{(42{,}650+21{,}300)2/(51{,}000\times 0.7854)}=\sqrt{3.19}$$
$$=1.785 \text{ in.}$$

The nearest root diameter of National Standard Thread is 1.962 inches and corresponds to a 2¼-inch thread. Thus, the size factor, expression (5) and TABLE I, (M. D., June, p. 17)

$$e_{sz}=1-0.4(1-0.85)/(2.25-0.5)=0.895$$

The varying loads on this rod end are

$$P_1=42{,}650+21{,}300=63{,}950 \text{ lb.}$$
$$P_2=P'=21{,}300 \text{ lb.}$$

(*Concluded on Page* 75)

Addition of cerium to new nickel-aluminum alloy improves casting properties, permitting casting of these intricate parts

Light Alloy Improved by Cerium

WHILE alloys of nickel and aluminum are not new, they are in relatively early stages of development. Chiefly, they have been used for pistons and cylinder heads in internal combustion engines and for die cast parts in meters and other light machinery. Like other developments in this field, the new British alloy "Ceralumin 'C'" brought out by J. Stone Co. Ltd., London, is a casting material and was produced primarily to meet requirements of low specific gravity, strength and good casting properties.

While the new material resembles in its composition other alloys in the nickel-aluminum group it differs from them in the fact that it contains a small amount of cerium—one of the rarer of the alloying elements.

Analysis of the alloy, which is covered by British patents, shows copper 2.5; nickel 1.5; magnesium 0.8; iron 1.2; silicon 1.2; cerium 0.15 and aluminum 92.65.

Investigations in the Stone company laboratories indicate that, in addition to its refining action on the microstructure, cerium allows the beneficial mechanical effects of a high iron content to be obtained by suppressing the embrittling iron-aluminum constituent which is otherwise likely to be formed. In addition the investigations seemed to indicate that the small amount of cerium also confers on the alloy numerous advantages in the foundry.

The heat-treament applicable to this alloy is quite simple. Castings are maintained at the solution temperature of 515 to 535 degrees Cent. for four to six hours and then quenched in water; ageing is achieved by heating to 175 degrees Cent. for 16 hours followed by quenching in water. The risk of distortion at the solution temperature is no greater than that involved, for example, in heat-treating "Y" alloy (Cu—4; Ni—2; Mg—1.5; Al—Bal) at 520 degrees Cent.

In the heat-treated condition Ceralumin "C" presents a combination of high tensile strength at ordinary and elevated temperatures, high elastic limit, high brinell hardness and exceptional fatigue strength of 18,500 pounds per square inch at 20,000,000 cycles.

Table of Properties

	Yield Strength (0.1% set) Lbs. per Sq. In.	Tensile Strength Lbs. per Sq. In.	Elongation* (per cent)	Brine'l Hardness Number
Chill-Cast				
Fully heat-treated	47,000-54,000	52,000-60,500	1.0	130-140
Quenched and aged 5 days at room temperature	29,000-32,000	42.500-47.000	4-6	98-104
As Cast	25,000-27,000	29,000-32,000	1-3	67-77
Sand-Cast				
Fully heat-treated	40,000-45,000	42,500-45,000	0-1	130-140
Quenched and aged 5 days at room temperature	25,000-29,000	32,000-36,000	1-3	98-104
As Cast		20,000	0-1	72

*The gauge length is 4 times the square root of the cross sectional area. In other words, for a specimen diameter of 0.505 in. the gauge length is 1.789 in.

Suitable for Heavy Duty Parts

Suitable for high-duty service in the form of die-castings, chill castings and sand castings, it is anticipated the alloy will find a useful field of application in the machine tool and other machinery building fields.

If after quenching, the ageing treatment described above is omitted, ageing at room temperature takes place and after five days a modified form of the alloy is produced, having somewhat lower tensile strength but increased ductility. This modification is intended for purposes where extra toughness is required in castings, such as for shrinking-on cylinder heads where heavy stresses may be set up and a little "give" in the casting is essential.

The new alloy was first presented in this country in *Inco,* published by International Nickel Co., New York.

Greatest Machine Show Ushers in New Era

By Harold B. Veith

MECHANICAL pageantry that defies description gave a new significance to design at the 1935 machine tool show in Cleveland last month. Never before has the ingenuity of the engineering profession been so highly praised and glorified. This hard-earned and well-deserved honor is indicative of a new conception the world has gained of technical endeavor. Some measure of the faith in technology that exists among business executives is revealed by the fact that sales for the ten days of the exposition exceeded $5,000,000.

Over forty thousand people thronged the five acres of exhibits that constituted the largest machine shop ever set up anywhere. Because the show was not open to the public, this tremendous gathering of industrial men represented genuine interest and buying power. Exhibitors who spent about $200,000 for space to display their developments were highly gratified with the results of the venture.

All indications are that the days ahead will be brighter for the machine tool industry, considered one of the best barometers by which to gage future business conditions. The index of machine tool sales in August stood at 125.8, a sharp increase over July. Thirty-seven per cent of this increase can be credited to purchases of foreign countries.

From a design standpoint the exposition was extremely impressive. Increase in the use of hydraulic controls and pumps in the operation of various types of machine tools stood as testimony of the efforts designers have put into innovations during the past several years. Many of the ideas behind developments shown were products of the depression and had their beginning in the darkest days of the business slump. This alone exemplifies the vision possessed by the builders of this class of equipment.

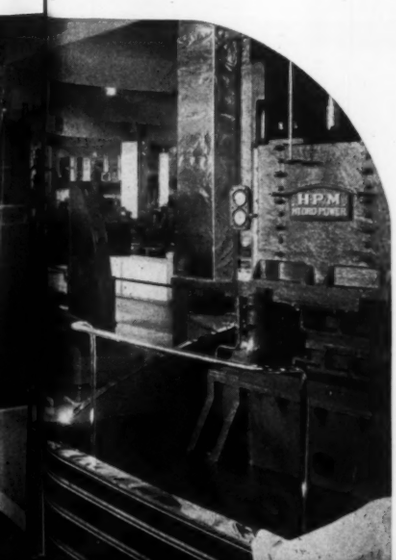
New Achievements in Drives

Progress was particularly apparent in the various forms of transmission systems. The use of V-belts, silent chain drives, improved gearing, etc. has played a big part in the improvement of machinery. In one case a lathe manufacturer has placed the geared speed change unit inside the cabinet leg of his machine and drives the spindle through a V-belt. Thus no gears are mounted on the spindle. Considerable interest was incited by the Cone worm gear wherein the entire tooth depth of the worm thread and wheel tooth flanks are in contact in operation. In this

SIGNIFICANCE of the machine tool show cannot be overlooked. If other exhibitions during the balance of 1935 and through 1936 measure up to the same standard, there can be no question but that boom times are ahead!

design, the load is distributed over a greater number of teeth, resulting in quieter and smoother operation.

Speaking of quiet operation, too much praise cannot be accorded designers on their accomplishments in this direction. Despite the fact that virtually every exhibit had machines in operation it was possible to carry on conversation without raising the voice appreciably. While it would be impossible here to delineate the various means employed to obviate noise, one that deserves mention is the B & S silent stock support employed on automatic screw machines. The device embodies a flexible metal guide in which the stock rotates, supported by a non-metallic material such as leather, which deadens sound and prevents transfer of noise to the metallic supporting parts. This idea is particularly advantageous where hexagonal or square stock is used. The device gives still more quietness because of the grease that fills the long tubular members, forming a cushion for the stock.



Missing were the old-fashioned oil and grease cups that a few years ago characterized all machines. Now lubrication is not left to chance. Improved systems that are positive and insure an adequate supply of oil to every bearing are being used extensively. Not only has the installation of automatic and semi-automatic systems increased efficiency and reduced maintenance cost but it enhances appearance.

The trim appearance of the units exhibited was quite in keeping with the appointments of the entire auditorium which housed the show. Machines did not seem out of harmony with cut flowers and modernistic furniture of chrome plated steel and leather construction that graced exhibitors' booths. One saw many designs that blended well into the surroundings. Unification and building-in of controls, proportioning of mass and care in finish has done much to improve appearance as well as increase utility.

While a great deal of welding was obvious in the design of the hundreds of pieces of equipment the place of castings continues to stand firm. Through metallurgical advancement they have been made lighter in section and have been shorn of much of that massiveness and heavy appearance that one time prevailed to harass designers. For example, one of the outstanding characteristics of the nickel cast irons now used in machine tools, which make them particularly useful for heavy duty parts is the greater stiffness of the alloyed material. These alloy irons are close grained with adequate hardness in heavy sections, yet machinable throughout. They also provide strength, stability, rigidity, resistance to wear, shock and warpage and dampen vibration to a greater extent than steel.

Materials Benefit Design

Meehanite, a material that is basically a high strength cast iron, wide use in the machines exhibited. Applications include cams, gibs, gears, housings, rams, air-cooled brake drums, crossrails, etc. The refinement of engineering materials has had a large share in the progress of the machine tool.

Mechanical design features that characterized the machines could be itemized by the hundred

(*Concluded on Page* 74)

Roller Bearings Take Shock of Rock Crushing

By A. L. Munro
Chief Engineer, Smith Engineering Works

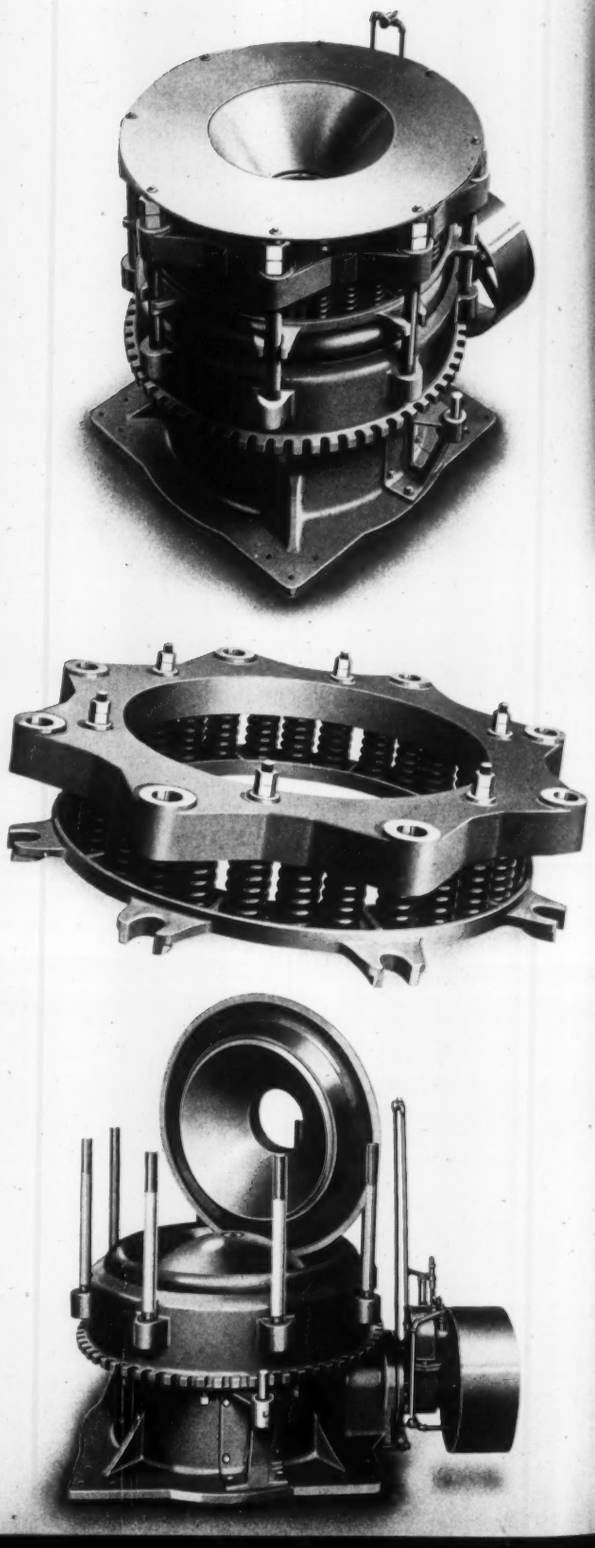
MOST people would hesitate before classifying the crushing of rock as a delicate operation. Also, it is extremely doubtful that quietness can be included as one of the attributes of this crushing. Yet antifriction bearings, ordinarily employed in fine precision machining and for quiet running, have recently been adapted to the design of a gyratory rock crusher.

These bearings, of the thrust, cylindrical roller type with hardened steel races and rollers, are employed on the Gyrasphere of Smith Engineering Works, Milwaukee, *Fig.* 1, top. Their use is dictated by a number of considerations in addition to the saving of power effected. Interposed between the head and the eccentric, *A* in *Fig.* 3, the roller bearings provide rotation of the head support in a manner that assures uniform wear and maintains the shaft in permanent alignment with the eccentric bearing. Placed below the eccentric, *B* in *Fig.* 3, the bearings take all vertical crushing pressures and transmit them back to the frame of the machine. In their development, the bearings were especially designed for heavy duty crushing and allowance has been made for the severity of such service.

Employs Unique Crushing Action

The use of these bearings was necessitated by the unique crushing action employed. The crushing head is impelled both by a gyrated shaft and a cam action produced by a supporting eccentric and the roller thrust bearing. Owing to the spherical form of the head, the major portion of the crushing action is accomplished by an upward thrust, rather than a sidewise stroke of the head. Consequently the crushing pressures are largely transmitted downward to the

Fig. 1—*Springs for compression, center, are easily removed as a unit from rock crusher, top. Breaking of rock is around a sphere, bottom*



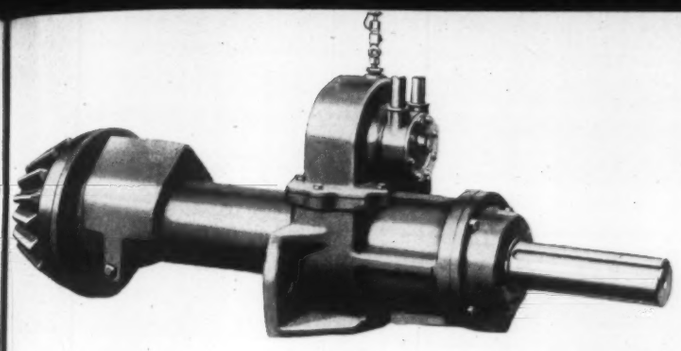
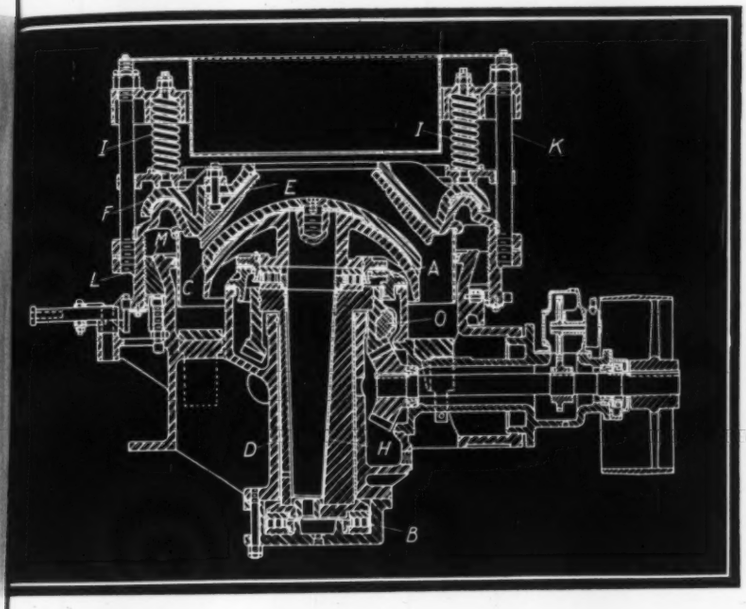


Fig. 2—Oil pump of the self-priming internal gear type is mounted on the countershaft unit

Fig. 3—Roller bearings between the head and eccentric provide ease of rotation and assure uniform wear



end-thrust bearings *B*. Horizontal pressures transmitted to the eccentric bearings are proportionately reduced. By this design bell-mouthed eccentric sleeves are avoided. Also, the design facilitates the maintenance of the shaft in permanent alignment; and gears are kept in mesh without trouble.

Breaking the material "around a sphere" characterizes the crusher. In operation, the manganese spherical steel head, *C*, *Fig.* 3, also shown in *Fig.* 1, bottom, fixed on an alloy steel shaft is gyrated by eccentric *D*, which is journalled in the frame. This frame is a heavy steel casting selected for strength and stability under heavy crushing loads. Between the manganese steel head and the annealed steel casting affixed to the shaft, zinc is poured to insure positive co-operative action. The second crushing member is a manganese concave ring *E*, *Fig.* 3, supported on the frame by means of a cast steel concave bowl, *F*. Zinc also is poured between these two parts to prevent movement between them.

The eccentric is bored at an angle to the axis of the crusher, with the center line of the shaft intersecting the true axis of the machine at a point above the crushing head. The upper face of the eccentric is machined at a right angle to its bore, and the thrust bearing *A* is interposed between this eccentric and the head.

When the crusher is empty the head will spin, due to the friction between the head shaft and the eccentric bearing *H*, a machined leaded bronze sleeve. As the rock to be crushed enters the receiving opening, this spinning action throws it into the crushing cavity where it is subjected to the crushing action between the gyrating head *C* and the concave ring *E*. As soon as the bowl fills up and crushing begins, the head stops spinning, as the friction between the head and the rock is greater than the bearing friction. When crushing, the gyrating crushing action of the head on the rock causes the head to revolve very slowly in the opposite direction, assuring an even wear on the manganese head. The eccentric is driven through a set of cut steel bevel gears from the countershaft, which in turn is driven from a flat or V-belt drive from an outside power source.

Pump Is Gear Type

Countershaft unit *Fig.* 2 consists of a heavy cylindrical casting on which an oil pump of the self-priming internal gear type is mounted between the end bearings as shown. The countershaft is journalled on standard tapered roller bearings in such a manner as to eliminate the need for an outboard bearing. The complete unit may be removed without dismantling other parts of the crusher.

The pump *J*, *Fig.* 3, is driven from the countershaft by a set of cut gears completely enclosed and running in oil. Lubricating oil is piped under pressure from the pump to the bottom of the crusher and to the sight feed oiler screwed into the top of the pump gearcase.

Pressure Is Kept Constant

Pressure is kept constant by an automatic relief valve from which the surplus oil flows back to the oil tank, *Fig.* 4. The sight feed regulates the flow of oil to the pump shaft and countershaft bearings. Oil which is forced into the bottom of the crusher, flows up through the inner and outer eccentric bearings as well as floods the bottom roller thrust bearing. The oil passing up the inner eccentric bearing flows over the top and lubricates the upper roller thrust bearings. Overflow from the outer eccentric bearing pours over and lubricates the main drive gears. All this oil collects in the bottom of the gearcase which surrounds the eccentric housing and is drained downward into the oil sump beneath the drive pinion.

Oil drains by gravity from the sump beneath the drive pinion to the large storage, settling and cooling tank. The rectangular tank, *Fig.*

4, is divided into two compartments by the baffles *E*. The fifty-mesh cylindrical oil screen *A* is open at both ends. The lower end fits into the top of a solid metal cylinder which has the lower end welded to the tank bottom. The top of the screen extends above the surface of the oil, return oil flowing into the top of the screen, then out into the settling compartment. The coarser grit as well as any water in the oil settles to the bottom. A pet cock *B*, *Fig.* 4, underneath the tank allows the draining out of the impurities that collect inside the screen. Baffles *E* are arranged so as to prevent any impurities of either a heavier or a lighter specific gravity than the oil from entering the pure oil chamber, from where the oil is pumped back to the crusher. An oil gage shows the oil level at all times.

As extremely gritty and dirty water as well

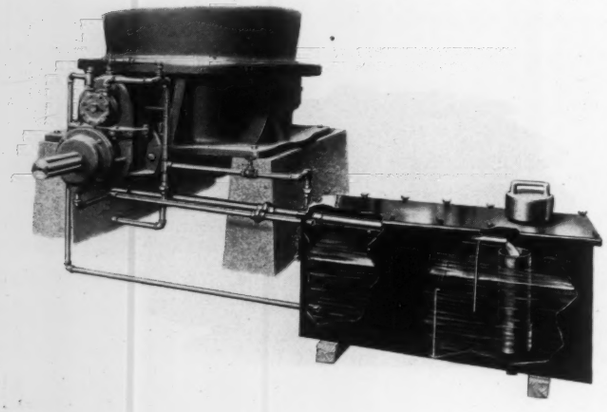


Fig. 4—Oil tank is divided into two compartments to obtain a clean supply of lubricant

as dust and grit often enters the crusher with the rock, it is absolutely necessary that seals be used that will keep such water and dirt from filtering into the lubricant and thence into contact with the bearings. Flexible leather labyrinth seal rings which revolve on different centers at an angle to one another are employed in the crusher. The outer and lower portion of the eccentric collar is machined true to the crusher axis and revolves around the frame hub. The flexible leather rings are fitted into the frame grooves and extend into corresponding grooves in the eccentric collar, preventing entry of dust and water. The upper part of the eccentric collar is machined concentric to the mainshaft, and the grooves in its upper face align with corresponding grooves in the bottom face of the head-collar. Leather seal rings fit into and connect corresponding grooves in both parts. The flexibility of the oil-soaked leather compensates for any radial wear or movement which may take place during operation.

Under normal crushing conditions, the concave retaining bowl *F*, is pressed snugly against the adjusting collar *L* by springs *I*, *Fig.* 3, but when packed by fines or by tramp iron these springs will yield, allowing the crushing unit to rise momentarily at the point of stress until the undue pressure is relieved. In earlier designs, individual springs held the unit in place, but these single springs have been replaced by a self-contained unit, protected by the feed hopper with which it is much easier to adjust all the springs to the correct compression. Also, this assembly, *Fig.* 1, center, is easily removed as a unit without the complete release of the compression and thus dismantling of the crusher is simplified.

Retainer Rings Hold Springs

Springs are held in place, top and bottom, by two retainer rings. and are compressed by bolts drawing the two rings together. The spring unit is loosely mounted on top of the concave bowl *F*, *Fig.* 3, and compressed to the desired amount by compression bolts *K*. Concave unit *F* is the only spring pressed against the adjusting collar and is free to creep during crushing. This rotation, while imperceptible, is sufficient to assure uniform wear of opposing surfaces. This feature also eliminates any tendency to rotate and loosen the screw adjustment.

The Gyrasphere is easily adjusted to meet a wide range of requirements. Adjustment is accomplished by collar *L*, *Fig.* 3, interposed between spring unit *L* and the frame. This collar engages with a segmental wedge-shaped adjusting screw *M*. To change the opening, the operator turns down the clamp screws under ring *M*, thus loosening this ring. Adjusting collar *L* is then moved up or down by means of a lever which co-operates with the toothed circle shown in *Fig.* 1, top. Owing to the segmental character of the inner adjusting screw, there is no tendency on the part of the adjusting rings to stick together.

Counterweights Combat Vibration

Vibration in the crusher, which might become a dangerous factor, menacing the life of the machine, is obviated by counterweight *O*, *Fig.* 3, affixed to the side of the eccentric which evens out the force and permits smooth operation.

The feed of rock is an unregulated and unlimited choke feed, the stream of rock being maintained into the crushing bowl at all times by keeping the hopper heaping full. Discharge is by gravity through a three-arm bottom spider, spider arms being protected by steel shields. There is no built-in discharge, the chute being independent of the structure and so designed that it may be attached at any desired position. to suit the job.

Helium Gas Replaces Mechanical Device

By E. W. Weaver

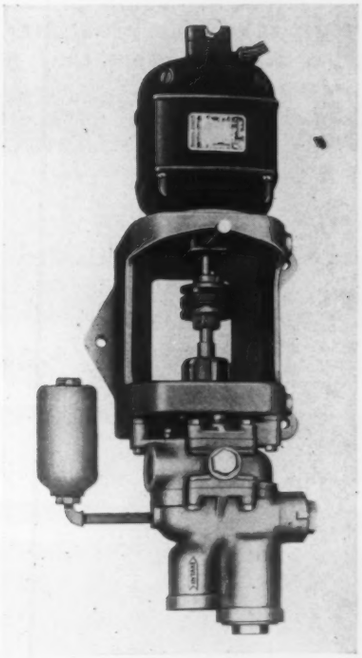


Fig. 1—Relief mechanism is directly connected to gasoline pumping system

MECHANICAL design is usually associated with the utilization of metals, wood, fabric and similar materials that can be seen and felt. In the particular problem of design described in the following, the central factor was a bit of helium gas, about 1/30 of a cubic foot in quantity, at atmospheric pressure and costing about ½ cent. This gas has been applied to gasoline pumping equipment, eliminating the danger of excessive pressures due to expansion caused by temperature changes.

In recent years the popular pumping equipment for gasoline dispensing stations has been electric motor driven pumps. In what is called a "wet hose" system all the space beyond the meter is completely filled with gasoline — piping, visigage, hose and nozzle — up to the discharge valve. All such pump systems, drawing from an underground tank, have a check valve at the lower end of the suction pipe to prevent the liquid draining back into the tank, and so making it necessary to "prime" the pump.

Hot Weather Causes Swelling

With many of these systems excessive trouble developed in hot weather, due to the expansion of the liquid under temperature rise setting up high pressures. The "swell" of gasoline is about 0.6 per cent for each temperature increase of ten degrees Fahr. As the rise may be as much as forty to fifty degrees between the cold underground tank and the pump, standing in the hot sun, there is a considerable volume of expansion to be cared for. The amount of liquid above ground and subject to this expansion is ordinarily not much more than one gallon.

The Underwriters' Laboratory, whose approval is necessary for all equipment for insured stations, takes cognizance of this situation by requiring equipment, not provided with pressure relief means, to be hydrostatically tested to 300 pounds per

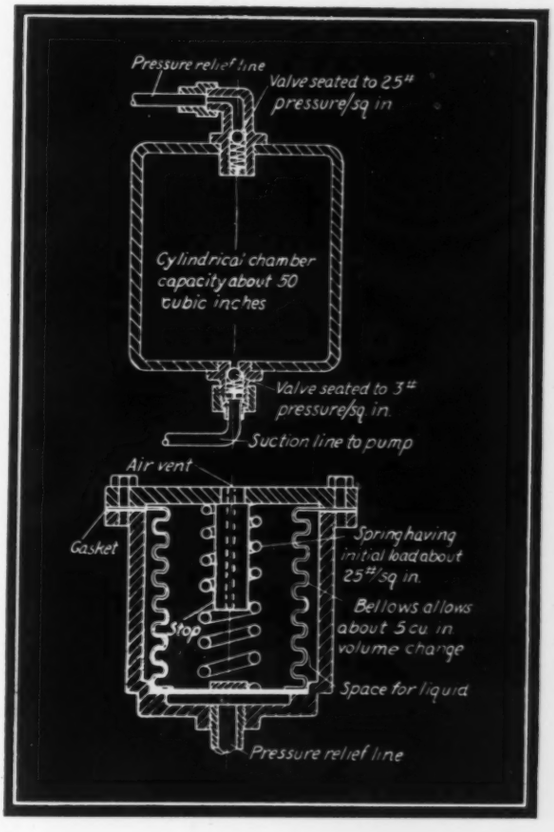

Pressure relief line
Valve seated to 25# pressure/sq in
Cylindrical chamber capacity about 50 cubic inches
Valve seated to 3# pressure/sq in
Suction line to pump
Air vent
Gasket
Spring having initial load about 25#/sq in
Bellows allows about 5 cu in volume change
Stop
Space for liquid
Pressure relief line

Fig. 2—Pressure control systems have taken many forms, as indicated, but usually have had inherent disadvantages

square inch. With a pressure relief system, it must take care of a fifty-degree temperature rise with not more than fifty pounds pressure increase.

Some equipment was built using an expansion air chamber similar to those used on small water pumping systems. As long as air stayed in the chamber it would do its work; but, as gasoline has a great affinity for air, absorption at a rapid rate resulted. When the air was exhausted, conditions were just that much worse, as the volume of liquid was correspondingly greater.

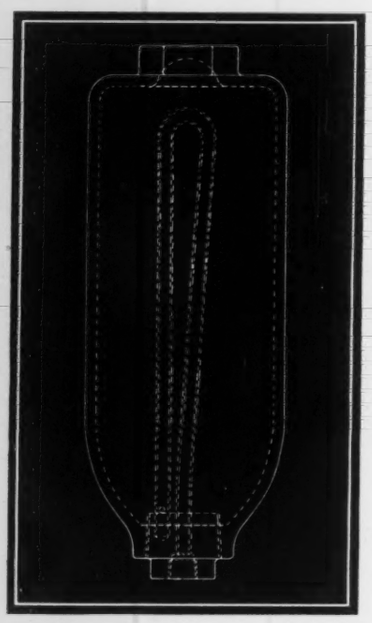


Fig. 3—Inlet pipe is arranged in the form of a U to avoid agitation, mechanical mixing, and escape of gas if device is placed upside down by accident

Relief systems have been worked out and used as follows:

I—A small chamber, normally empty, as it is connected to the suction side of the pump through a valve with a very light spring. Pressure relief is obtained through connection to the system through a valve which opens to pass liquid into the chamber only when the pressure rises to a predetermined point. (*Fig.* 2, above).

II—A chamber having a corrugated metal element, capable of being expanded and contracted under pressure variations—Sylphon bellows pressure and temperature control systems. (*Fig.* 2, below).

As both these systems have their disadvantages and are costly to build, search was made to determine whether or not a simpler, cheaper, and more dependable method could be worked out. Starting on the theory that atmospheric air would do the work perfectly if it would "stay put", it seemed that if some gas could be found which would not be absorbed by gasoline the problem would be solved. Reference to a handbook on gases showed helium to have a valence (ability of the atom to combine with atoms of other materials) of 0. It, therefore, seemed specially adapted for the job. It was a fairly simple matter to work out a proper sized chamber — with inlet pipe arranged in the form of a U to avoid agitation and mechanical mixing and to permit of necessary handling in making connections without loss of the gas. In the event of the chamber being placed inadvertently in a position with the pipe connection uppermost and open, the loss of the helium gas would be confined to the amount contained in the open side of the U-tube. *Fig.* 3 shows the final design of the device as supplied. *Fig.* 1 shows it connected to the pumping system in general use.

Pressures Kept at Low Level

The capacity of 57 cubic inches is sufficient to insure that the ordinary system is never subject to higher than pump bypass pressure. The controls are used on pumps where actual trouble is experienced. (If there is a slight leak in the system — check valve, suction line, pump packing or gaskets, or even in the hose or nozzle—pressure does not rise to a troublesome point). Later developments in the gasoline pump field have introduced another element known as an "air eliminator" which, as one of its functions, provides contact with the atmosphere, and so obviates necessity for other pressure relief means.

A couple of interesting psychological phases came up in the short development history of this device:

I—A little knowledge being a dangerous thing, the production department reported to the management that it was absolutely impractical on account of the cost of the gas, quoting chemically pure helium gas in glass bulbs at $11 per liter, or about a quart. Availability of 96.7 pure helium at $28 per 200 cubic feet, however, made it entirely practical.

II—The flat statement by persons who should have known better that helium would be better than air but would not last more than twice as long.

This latter statement was offset by comparative test, in which duplicate glass chambers were arranged to compare absorption qualities. As normal pumping pressure is about 8 pounds per square inch and by-passing pressure about twice that, plans were made to circulate gasoline through each chamber at the rate of one pint per minute under 8 pounds pressure during the day, and to let them stand overnight with 16 pounds pressure but no circulation. After 130 hours of circulation with pressure and 250 hours of the greater pressure without circulation, the liquid level was no higher in the helium-filled bottle than at the start of the test.

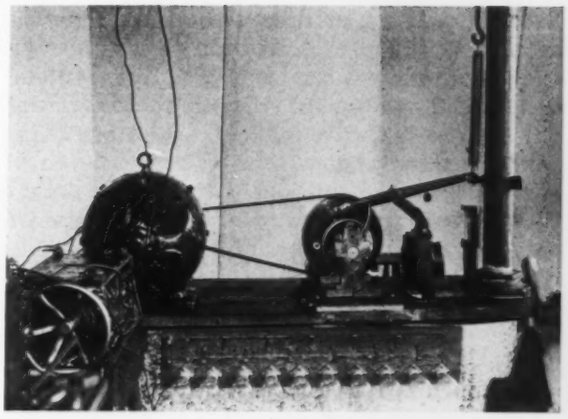


Fig. 1—Variable-speed motor drives the camshaft through belt and pulley in spring testing mechanism

Don't Overlook Surge in Designing Springs!

By C. H. Kent
Professor of Mechanical Engineering, Pennsylvania State College

SURGING will take place in any spring extended or contracted periodically and may account for the breaking of springs, cams, or rollers in many applications. Springs used under such conditions vary in size from a few inches in length as used in motors to a few feet as used in textile machinery. The phenomenon known as surge in the valve springs of internal combustion motors has been investigated thoroughly by engineers here and abroad in the last few years. This has done much to explain the breaking of valve springs especially in airplane motors.

Extension Travels Along Spring

When a force acts on the end of a tension spring and extends it, this force is communicated by the end coil to the next one, which is extended and in turn communicates the force to the next coil; thus the extension travels the length of the spring. Time is required to change the position of the coils in response to the pull on the end and the motion of the coils appears as a wave travelling along the spring, and is referred to as a surge. The surge will be reflected from the ends of the spring and will continue its motion until damped out by friction.

The speed of travel of the surge will depend on the dimensions of the spring and the elastic constants of the material of which it is made. If the periodic force is applied at such times as to coincide with the return of the surge to the free end a condition of resonance results and forces will be set up which may result in failure of the spring or connecting parts of the mechanism. Such a failure, if in the spring, usually occurs in the end coils. The relation between the timing of the force and the speed of the surge may be just that required to damp out the surge entirely or, as usually happens, there will be no simple relation and the movement of the spring will be complicated by reflected waves superimposed on the principal surge produced directly by the force.

Devises Special Apparatus

To study this phenomenon the apparatus shown in *Fig.* 1 was set up in the laboratory of the department of mechanical engineering at The Pennsylvania State college[1]. A variable speed motor was used to drive the camshaft through a belt and pulley, the latter having sufficient flywheel effect to maintain a constant angular velocity of the shaft. A periodic force may thus be applied to the lower end of the spring by the cam lever. The whole apparatus was rigidly mounted and the spring hung from a fixed hook.

Thin lines were scribed with a diamond-pointed tool on each coil in a plane perpendicular to the axis of the spring and the measuring device shown in *Fig.* 3 used to determine the distance between these lines. The pointer of the measuring device was raised or lowered by a threaded spindle moved by a ratchet at its base

[1]The experimental work described here was carried out by T. G. Stoudt.

so calibrated that a revolution of one tooth of the ratchet raised or lowered the pointer 0.005 inch. The Edgerton stroboscope shown was used to read the pointer while the spring was in motion. Speed of the stroboscope was brought to the point where no motion was apparent in the coil. The timing of the contactor was then varied until maximum coil openings were observed and readings then taken. When these readings were compared with those taken with the cam roller stationary on the high point of the cam, the difference gave the increased deflection of the spring due to surge only.

Employed on Knitting Machine

The spring and cam assembly shown here were used on a knitting machine operating usually at a speed of 72 RPM and with an initial tension of 75 pounds. *Fig.* 2 shows the curve obtained by plotting the deflection of the end coils due to surge against speed of the camshaft. It is seen that even a slight change in speed produces a marked change in this deflection. Obviously 72 RPM is the worst speed in this range at which the spring could be operated.

Fig. 4 shows how the increase in deflection caused by surge varies when the cam is operated at a speed of 72 RPM and the initial tension varied. Again the operating condition was the worst. A slight change in speed or in initial tension would reduce the maximum spring tension and thereby reduce the number of broken cam rollers.

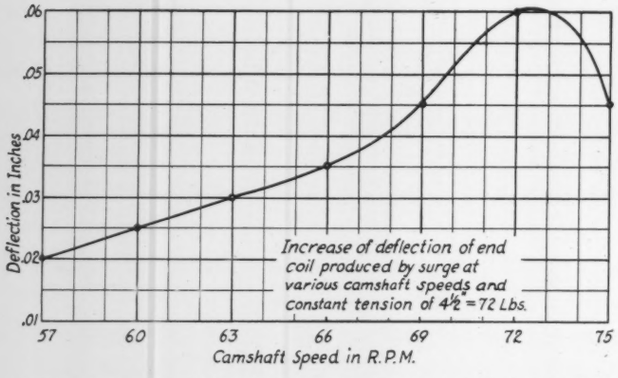


Fig. 2—As indicated by the curves, a slight change in speed produces a marked change in deflection

Available Formulas Not Close

These investigations show that surge is an important factor in the behavior of springs in many applications, even in those of relatively low speed. By test it is possible to determine the speed of the cam and the initial tension which will reduce the effect of surge in any given spring to a minimum. The results also show that the available formulas for determining the natural period of such springs do not give results sufficiently close to the actual to be of much use.

The problem of the natural period of surges in springs is treated by Love[2], but the results are too complicated to be generally used. Simmons[3] has given the following simple formula as an approximation to the results of Professor Love:

$$f = \frac{1}{2l}\sqrt{\frac{GJg}{r^2wA}}$$

where

f = frequency of surge in cycles per second
l = active length of wire composing the spring
G = modulus of rigidity of the material
J = polar moment of inertia of wire cross-section
r = radius of curvature of spring as loaded
w = weight of unit mass of spring material
A = cross-sectional area of wire

All of the above including g should be in inch-pound-second units. This formula may also be expressed for steel wire in other terms more convenient to use in some cases, as:

$$f = \frac{62.4dP}{r^2l} \times \sqrt{G}$$

where

d = diameter of wire
P = pitch of loaded coils

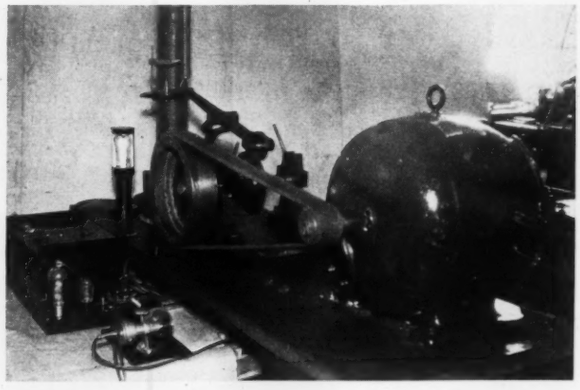


Fig. 3—Measuring device shown is used to determine the distance between scribed lines

The theoretical formulas shown in the foregoing invariably gave results higher than those shown on the actual spring by the stroboscope. This discrepancy varied from ten to fifteen per cent and should be taken into consideration by the designer. Further investigations may disclose whether the formula can be so modified as to give permanently satisfactory results or

[2]A. E. H. Love, "Theory of Elasticity."

[3]L. F. G. Simmons, "Investigation of the Fracture of Exhaust Springs." Report No. 241, Advisory Committee for Aeronautics (British).

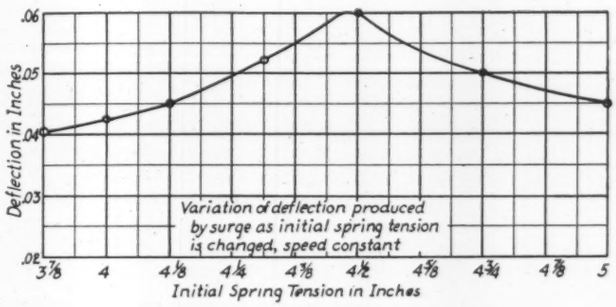


Fig. 4—Increase in deflection caused by surge varies when the initial tension is changed

whether the discrepancy noted is due to the unavoidable differences in diameter and pitch existing in the common coil spring.

Studies Weldability of Copper Alloys

MANUFACTURERS of brasses and bronzes have been actively engaged in the problem of developing alloys particularly suitable for fabrication by resistance welding methods. At the present stage of development, many types of brasses and bronzes can be spot and seam welded on standard welding equipment. Some alloys of copper require extra large capacity welders, but that is by no means true of all brass and bronze alloys.

Resistance welding current requirements are in direct proportion to the conductivity of the metals to be welded, and nonferrous alloys which require large values of electrical capacity are usually hard on welding dies and rolls

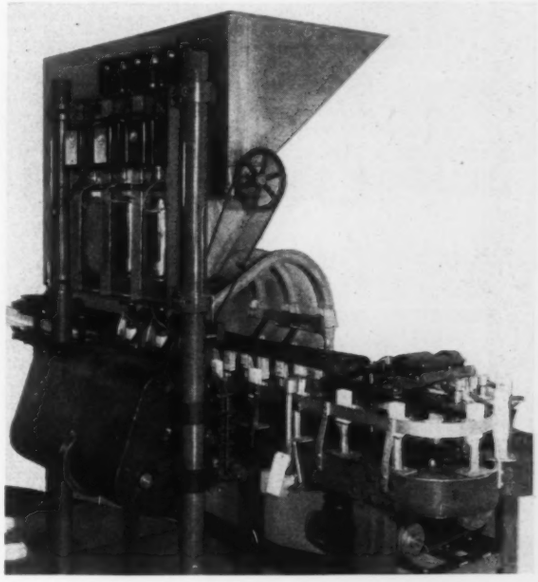
Replacing some of the zinc with other elements in the high copper families often has a favorable effect on the weldability of the alloy. Manganese, nickel, silicon and tin are particularly effective. This is true only as a general rule, however, because more of some elements beyond a definite point has a negative reaction. Aluminum, for instance, adds to the weldability of a copper alloy until 3 per cent has been added. From three per cent up, the weldability begins to decrease again.

According to Thomas-Gibb engineers, a bronze alloy with 85 Cu and 15 Sn is a very good alloy for resistance welding. Commercial bronze, 90 Cu, 10 Sn is also a good welding alloy. In the brasses, yellow brass, 66 Cu and 34 Zn and an alloy with 70 Cu and 30 Zn are good for welding.

Contactors Control Flow of Product

IN A new carton sealing and filling machine, recently developed by the J. L. Ferguson Co., the correct amount of the product delivered to the cartons is automatically controlled by three electric contactors. These contactors can be seen in the upper left-hand section of the illustration mounted behind the hopper. Above the contactors are three electric motors which drive the augers that feed the product from the hoppers, through the filling spouts, and into the cartons.

The machine operates as follows: A large hopper above the machine is filled with the product with which the cartons are to be filled. A chain conveyor brings three empty cartons directly under three filling spouts connected to the product hopper. When the three cartons are in perfect alignment with the bottoms of the chutes, a mechanically operated clutch disconnects the conveyor and stops the forward motion of the cartons. At the same time a switch closes the electric contactors. As the contactors close, each operates the small electric auger drive motor, starting the auger revolving in the filling spout, feeding the product simultaneously with the raising of the platforms on which the cartons rest, so that the product is packed into the cartons from the bottom for a clean, accurate filling job. When the cartons are filled



Operation of small electric auger drive motors at top is controlled by electrical contactors

with the correct amount of material, the contactors open and the motors (and the augers feeding the product) are stopped. The platforms with the filled cartons are then moved down off the filling tubes and into the path of the chain fingers. The clutch on the chain conveyor engages, and the filled cartons move away. Three empty ones take their places under the product hopper filling spouts.

The contactors used in this carton filling machine are of the solenoid type produced by Allen-Bradley Co. They open and close at the rate of up to twenty times a minute.

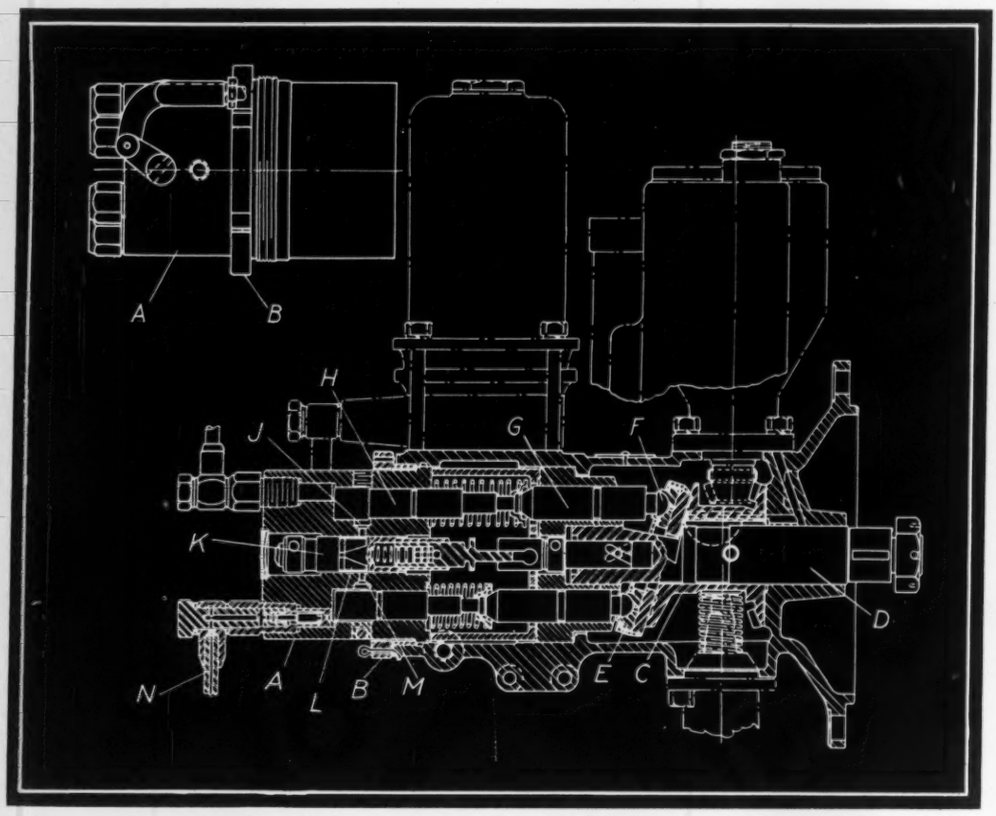


Fig. 1—Design feature of fuel pump is interchangeable valve mechanism

Self Contained for Interchangeability

WHERE exacting requirements are imposed on a machine or mechanism the designer can forestall difficulties in service by employing self-contained interchangeable units capable of being quickly and easily replaced. What can be accomplished by such procedure is impressively revealed in the design of the Ex-Cell-O fuel injection pump, *Fig.* 1, for diesel engines.

The hydraulic unit *A* which virtually is the heart of the device must always be in perfect adjustment. By locating all the pump plunger bores, by-pass holes and the central rotary valve bore in this one integral part of the pump, the designers have prevented any possibility of cumulative errors in manufacture and assembly; such errors would cause discrepancies in quantities of fuel delivered to each engine cylinder. The design insures that no adjustment can slip, change or be tampered with. Because the hydraulic unit is self-contained it can be removed and replaced by simply unscrewing ring nut *B*.

Design of the hydraulic device, which mounts on the driving unit, permits the use of a simple swashplate *C* that is keyed on the pump driveshaft *D*. Through the medium of shoe plate *E* containing spherical tappet sockets *F* the rotary motion of the swashplate is converted into harmonic reciprocating motion of the tappets *G* that have their axes parallel to each other and to the driving shaft. These tappets reciprocate in the tappet block, each operating a pump plunger *H*.

Advantages of the swashplate construction are the ample bearing surfaces made available and the fact that the thrusts from the pump plungers are symmetrical with respect to the pump driving shaft and are taken on a direct line to the swashplate thrust bearing. This line is close to the axis of the drive shaft, resulting in increased rigidity.

Reciprocating motion of the tappets is communicated to spring-returned plungers *H* which are in line with and contact the tappets. By-pass holes extend radially from each plunger cavity to a fuel supply belt *J* that surrounds the central rotary valve *K*, being broken only by a land *L* on the valve. Inasmuch as the rotation of the land is timed to close the by-pass hole during a portion of the expulsion stroke of the associated pump plunger, the period of injection will be governed by the duration of closing of the by-pass hole *M*. While this hole is closed the fuel is discharged through a conventional check valve and fuel tubing lead *N* connected with each pump plunger cavity. The design provides a wide range of delivery characteristics.

New Machines Indicate Design Trends

ELECTRICAL controls should be chosen more carefully than any of the other parts in the machine. Not because it is difficult to find a control to do the job, but because a careful choice will yield benefits far greater than those that can be obtained from the similar application of time to any other part.

Many of the most successful of today's machines have substituted complete electrical control for levers, genevas, and mechanisms of all types to secure exact operation of any number of involved steps. Electrical controls are one of the most flexible of design parts. If they can be adapted to the job the designer has in mind there is nothing more certain than that simplification will result.

Machines recently announced in addition to those on the next two pages include the following, arranged by fields of application:

Chemical

Centrifugal Bowl Mill,
Raymond Bros. Impact Pulverizer Co.,
Chicago.

Vibrating Feeder,
Jeffry Mfg. Co.,
Columbus, O.

Construction

Concrete Vibrator,
Viber Co.,
Los Angeles.

Portable Rock Crusher,
Four Wheel Drive Auto Co.,
Clintonville, Wis.

Domestic

Vacuum Cleaner,
Landers, Frary & Clark,
New Britain, Conn.

Farm Washer,
Altorfer Bros. Co.,
Peoria, Ill.

Vacuum Cleaner,
P. A. Geier Co.,
Cleveland.

Industrial

X-Ray Machine,
St. John X-Ray Service Inc.,
Long Island City, N. Y.

Pneumatic Press,
Hanna Engineering Works,
Chicago.

Shop Truck,
W. F. Hebard & Co.,
Chicago.

Heavy Duty Sander,
Black & Decker Mfg. Co.,
Towson, Md.

Laundry

Press,
American Laundry Machinery Co.,
Cincinnati.

Dry Cleaning Unit,
Smith, Drum & Co.,
Philadelphia.

Metalworking

Roto-Broach,
Bullard Co.,
Bridgeport, Conn.

Bench Lathes,
Rivett Lathe & Grinder Inc.,
Boston.

Bench Power Press,
Waterbury Farrel Foundry & Machine Co.,
Waterbury, Conn.

Feeding and Straightening Machine,
F. J. Littell Machine Co.,
Chicago.

Geared Head Engine Lathes,
Greaves-Klusman Tool Co.,
Cincinnati.

Universal Turret Lathe,
Foster Machine Co.,
Elkhart, Ind.

Mining

Drill Sharpener Furnace,
Ingersoll-Rand Co.,
Phillipsburg, N. J.

Rock Bit Grinder,
Mine & Smelter Supply Co.,
Denver.

Plating

Burnishing Barrel,
Hanson- Van Winkle-Munning Co.,
Matawan, N. J.

Packing

Electric Screw Capper,
Scientific Filter Co.,
New York.

Quarry

Shaker Screen,
Continental Screen Co.,
Kokomo, Ind.

Drill Rig,
Cleveland Rock Drill Co.,
Cleveland.

Restaurant

Bottle Breaker,
Cochrane Corp.,
Philadelphia.

Ice Cube Maker,
Fedders Mfg. Co. Inc.,
Buffalo, N. Y.

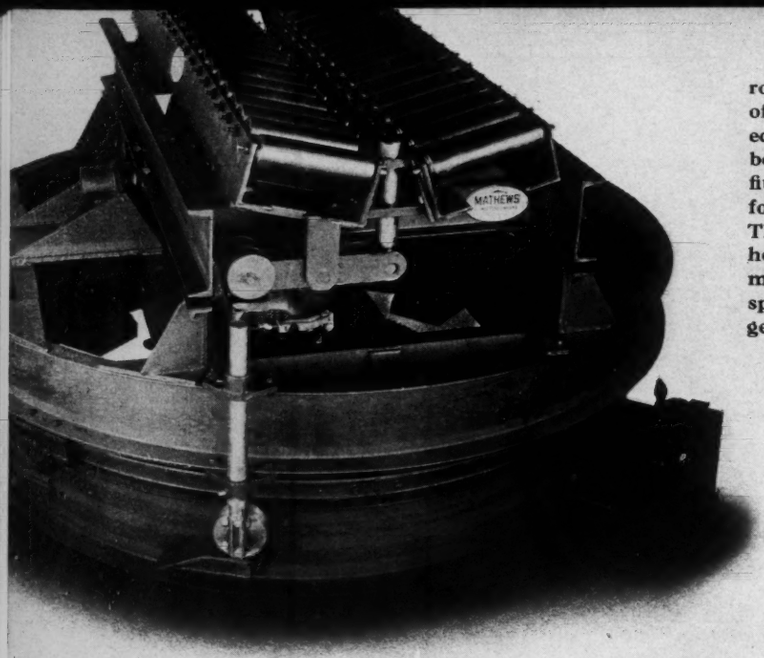
Textile

Double Deck Winder,
U. S. Textile Machine Co.,
Scranton, Pa.

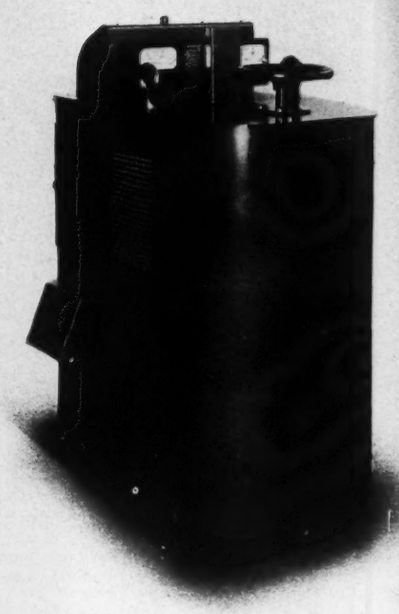
Duplex Sewing and Rolling Machine,
Hermas Machine Co.,
Hawthorne, N. J.

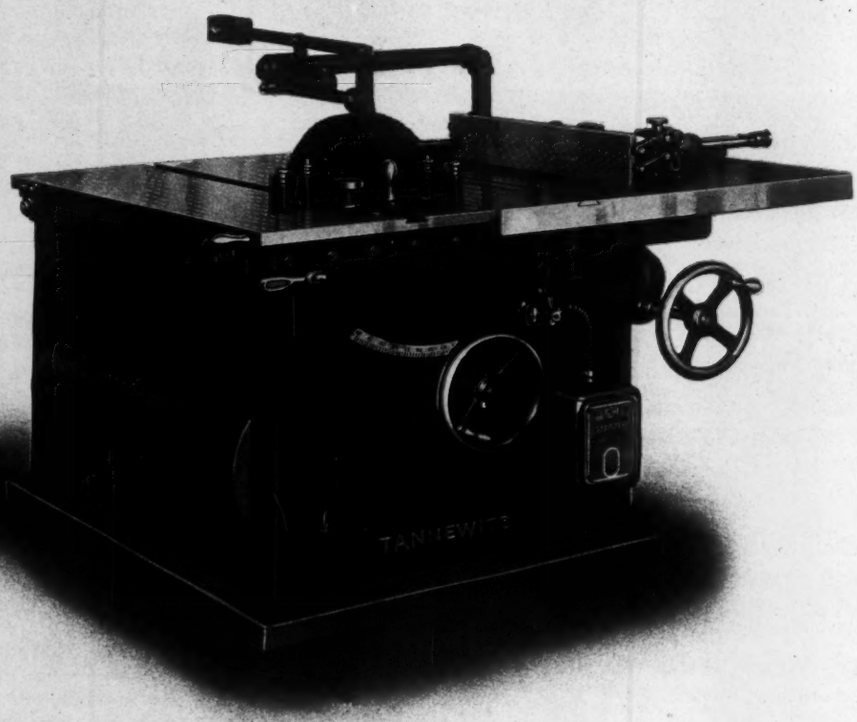
Multiple and Single Wrap Knitter,
Standard-Trump Bros. Machine Co. Inc.,
New York.

Singeing Machine,
H. W. Butterworth & Sons,
Philadelphia.



INDIVIDUAL rollers in conveyor section of Mathews power-operated turntable, left, are ball bearing, grease packed type fitted with grease fittings for periodical lubrication. The unit is driven by a 5 horsepower Westinghouse motor coupled to a vertical speed reducer and spur gears.

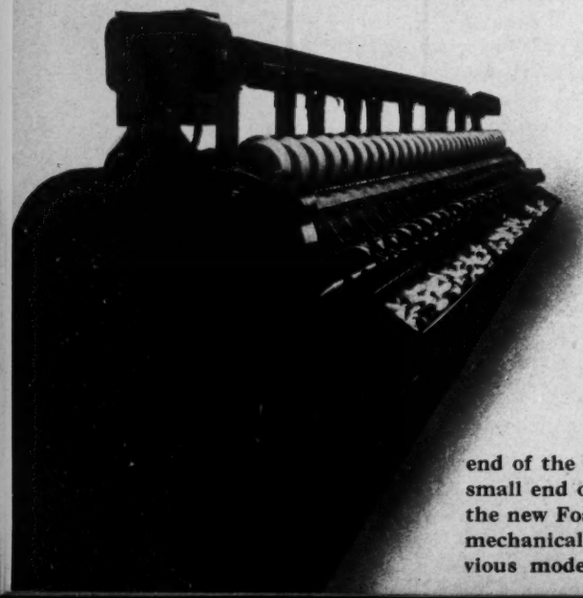




MOTORS are mounted directly on the arbors of tilting arbor saw bench of the double revolving arbor type, right. Construction of this Tannewitz machine is simplified and strength of moving parts is increased by making use of welded steel plate construction and by the use of a double screw, table tilting mechanism. Arcing and consequent wear is obviated by use of a rotary switch which is so constructed that the current is cut off before the brushes lose contact with the segments.

UNIVERSAL tester of Amthor right clamp speeds the are machine operator th

THE latest type N. A. A. flaps which permit increased top speed possible the use of full power in climb engine is employed on new Chance Vo airplane, below. Structure of the plane covering, except for the fixed tail surfaces covered.

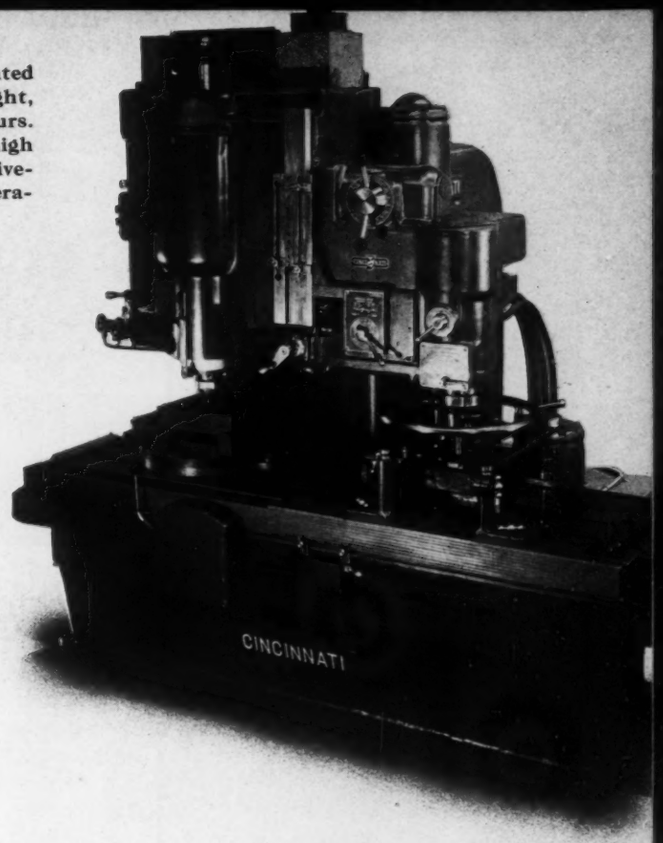


NO GEARS are mounted on the spindle of high-speed shaft turning lathe, below. The gear-speed unit is mounted inside the cabinet leg and provides n cal changes of spindle speeds. Drive is by V-belts.

A LOOSE shell at the end of the parallel roll on which the small end of cone rests overcomes in the new Foster cone winder, left, the mechanical details present in previous models.

AN AUTOMATIC control cuts
Westinghouse welder, left, off the line
when the operator stops work. It is brought
back on the line by a momentary contact
made by a switch in the holder. This
welder gives relatively high currents for
fast production.

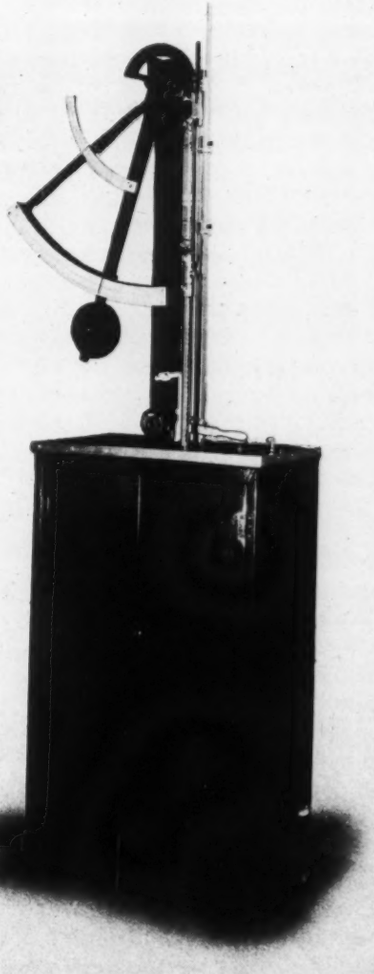
HYDRAULICALLY operated profile and die-sinking machine, right, accurately reproduces forms and contours. Built by Cincinnati, it combines high cutting capacity with flexibility, sensitiveness of control and convenience of operation.



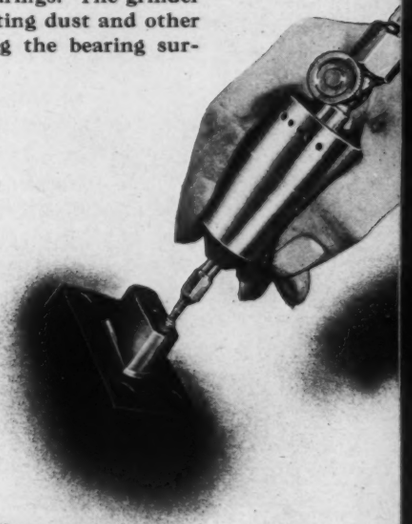
Design Features in New Machines

A Pictorial Presentation of Recent Machinery from the Standpoint of Design.

UNIVERSAL tensile strength and elongation
of Amthor weight, is motor driven with variable pulling
speeds that are standard for various materials. The
machine operates on the pendulum principle.



ALUMINUM and special high grade steel have been used to produce Super Speed air grinder, right. The shaft revolves on two ball bearings. The grinder is self-cleaning, preventing dust and other abrasives from reaching the bearing surfaces.



Type N. A. C. A. cowl with adjustable
gills increased top speed as well as making
more power in climb without heating the
engine. New Chance Vought scout-bomber
one of the planes is metal, with fabric
covered tail surfaces, which are metal-

the spindle of Monarch
lathe geared speed change
provides 16 mechani-
cal V-belts

A NEW principle in crawler suspension is employed on Barber-Greene loader, right. The oscillating axle consists of two cross axles, assembled as a parallelogram, which keeps the crawlers parallel at all times. The main frame is a welded box in which all driving mechanisms are contained.

MACHINE DESIGN

Quest for Good Designers Indicates Greater Design Activity

THAT there will be a "breathing spell" in design—at least as far as machine tools are concerned—is the belief of one of the speakers at a meeting held in conjunction with the Machine Tool Show last month. This let-up, he feels, is necessary in order that manufacturers may earn a return on the cost of revolutionary changes incorporated in machine tools developed over the past year or so.

In considering any such cessation in design however, two pertinent factors arise: Many of the machines exhibited at the Show are intended primarily for automobile production, and only those machines that have been fully developed and tested were on exhibition. Many others—for general production as well as automotive—are in the development stage, and still others in their early stages on the board. These embryo designs will mature just as quickly as business conditions return to normal—consequently, judging from present indications, no protracted retardation in design is imminent.

Particularly is this so in the case of machinery other than machine tools. Machine designers are in demand again, which fact emphasizes the urge on the part of manufacturers to meet potential requirements. From the appearance of the "Men Wanted" columns it would seem that there is a scarcity rather than an abundance of designers—conclusive evidence that more new designs are under way. Resultant competition will place in a hazardous position those who put too much emphasis on the idea that we are due for a breathing spell in design!

That Decides It!

OBSERVATION at the Machine Tool show proves clearly that the two outstanding developments in design of machine tools are the increasing use of hydraulics and the building-in of electrical controls.

A few years ago the use of hydraulics was a distinctly controversial subject. This method of feed control had previously enjoyed a run of popularity, but due to restrictions in hydraulic equipment available at that time a set-back was experienced. Intensive development of hydraulic controls during the past year or so has overcome the objections to the point where the majority of the machines at the show on which hydraulic feeds are practicable, were thus equipped. No further display of confidence is needed.

That these trends toward hydraulic and electric devices will spread quickly to other types of machinery is just as inevitable as was the spread of the idea of designing for appearance as initiated by the automobile industry.

Editorial

Professional Viewpoints

MACHINE DESIGN WELCOMES LETTERS SUITABLE FOR PUBLICATION

Designing Pivoted Motor Drives

To the Editor:

THE article by Dr. Tatnall in the May issue of MACHINE DESIGN on "What's Behind the Pivoted Motor Drive?" interested me greatly. Although, in his article, he goes deeply into the actions and reactions of the external forces effecting this particular type of drive, Dr. Tatnall passes over the effect of the internal forces, namely the reaction torque of the motor, with the following statement:

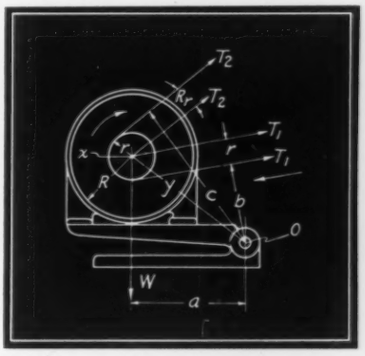
> "But—and this is important—having, in the derivation of formulas for the tensions, introduced the motor torque in terms of horsepower and speed as by the factors P and k in equations (3) and (4), the motor torque itself must then be forgotten, and is now represented by the changes in tension which it has produced and which would not exist without it."

While this statement is perfectly true, it is difficult to grasp unless one has taken the trouble to analyze the effect of this reaction torque. That there is reaction torque set up by an electric motor, anyone who has used a powerful electric drill or watched the dip of a motor on a pivoted motor base at starting will not doubt. In fact, a good many believe that, in calculating a drive of this sort, the reaction torque should be added to the weight moment of the motor when the tight side of the belt is nearest the pivot point and subtracted from it when the tight side is farthest away.

Dr. Tatnall's equation (1) states that $eW = aT_1 - bT_2$ or that the weight moment of the motor is equal to the sum of the moments of the tensions in the tight and slack sides of the belt. This is true for all loadings of the motor and apparently overlooks the effect of reaction torque.

Let us briefly review the major actions and reactions that take place in an electric motor. When a voltage is applied to the windings a twisting force or torque is set up which tends to rotate the armature. As there must be a reaction to every force however exerted, so there must be a reaction force or reaction torque equal to and opposite in effect to the twisting force or torque of the motor. A little thought will show that this reaction torque will tend to rotate the frame of the motor in a direction opposite to the rotation of the armature whenever resistance is applied to the motor pulley.

In the conventional mounting of a motor, where it is securely bolted to the building or machine frame, this reaction torque is absorbed in such mounting and is never apparent. However, when a motor is mounted on a pivoted base, as in the accompanying illustration, the frame is kept from rotating under the influence of the reaction torque by the pivot point. Thus, when the rotation of the motor is clockwise, the frame of the motor tries to rotate in a counterclockwise direction. Being held from rotation at pivot point O a tendency for it to rotate in a counterclockwise direction around this point is produced. This is what is most confusing. Why is not this reaction torque added to the weight moment of the motor in producing increased tensions in the belt when the motor is rotating as shown and subtracted from the weight moment when the rotation is opposite?



Analyzation of reaction torque is necessary for understanding of forces present when applying a pivoted-motor base

Let us see what actually happens. Assume first that the motor is at rest. T_1 equals T_2 since the armature is free to rotate and acts as an equalizer. These forces are transmitted to the frame of the motor through the armature shaft at point x and may be indicated as in the illustration. Taking moments about O.

$$Wa = T_1 (b + r) + T_2 (c - r)$$
$$= T_1 b + T_1 r + T_2 c - T_2 r$$

Since T_1 equals T_2, then $T_1 r$ equals $T_2 r$
Cancelling we have

$$Wa = T_1 b + T_2 c$$

Now give the motor some work to do and see what happens. Assume the rotation of the motor to be clockwise as shown. The torque of the motor tends to pull the belt in the direction indicated by the arrow. The belt, if given work to do, resists this movement and the pulley will

have a tendency to roll along the belt to the right. This translation of the pulley is prevented by the frame of the motor acting through the motor shaft. Thus a pressure on the motor shaft at point x is created, a pressure that is equal to T_1 and parallel to it. Correspondingly, a pressure is created at the same point by T_2 that is equal and parallel to T_2.

Now, T_1 exerts a twisting moment equal to $T_1 r$ in a counter clockwise direction about x, and T_2 a twisting moment equal to $T_2 r$ in a clockwise direction about the same point. The difference of these moments $(T_1 - T_2)r$ is the torque or twisting effort of the motor.

As we have seen in the foregoing, the reaction torque tends to rotate the motor frame in a direction opposite to the rotation of the armature, which in this case would be counterclockwise. This reaction torque may be indicated by the force R acting at x at a distance y from the pivot point. Again taking moments about the pivot point O we have

$$Wa + Ry = T_1 (b + r) + T_2 (c - r)$$

Now since the reaction torque equals the torque of the motor we have

$$Ry = (T_1 - T_2)r$$

Then

$$Wa + (T_1 - T_2)\, r = T_1 (b + r) + T_2 (c - r)$$
$$Wa + T_1 r - T_2 r = T_1 b + T_1 r + T_2 c - T_2 r$$

Cancelling we have

$$Wa = T_1 b + T_2 c$$

Showing that even when we take into consideration the reaction torque of the motor we still have the balance of external forces referred to above.

Similarly, when the rotation of the motor is counterclockwise, T_1 and T_2 as well as b and c interchange and the force R tends to produce clockwise rotation of the motor frame around the pivot point. Taking moments about the pivot point O we have

$$Wa = Ry + T_1 (b - r) + T_2 (c + r)$$
$$= (T_1 - T_2)\, r + T_1 (b - r) + T_2 (c + r)$$
$$= T_1 r - T_2 r + T_1 b - T_1 r + T_2 c + T_2 r$$

Cancelling we again have

$$Wa = T_1 b + T_2 c$$

That there actually is this balance of the three external forces has been shown conclusively by experiment. Thus we see that while the reaction torque of the motor is very much present and active, it does not add itself to or subtract itself from the weight moment but acts rather to offset the additional pull put into the tight side of the belt and maintain balance.

—Fred G. Munson
Worcester, Mass.

To the Editor:

I HAVE read with pleasure Fred G. Munson's comments on the derivation of equation (1) in my paper on the Pivoted-Motor Drive. His clear presentation will be a help to those who have had difficulty with the rather perplexing question of the relation between motor torque and belt tension.

To anyone who may be interested in comparing Mr. Munson's method of attack with my own, I should like to point out clearly the essential difference between them. He obtains his results by considering forces and moments acting on the motor frame, or stator, while I have preferred to work with the forces and moments acting on the system consisting of stator and rotor considered as a unit. As Mr. Munson has clearly shown, both methods bring the same result.

In the method which I used, as in most processes involving vectors, it is out of the question to transfer these to new positions, as Mr. Munson has done in shifting the belt pulls from the pulley rim to its center. In applying his method, however, we see that for the reason given, it is entirely legitimate to do this.

While I have the floor, I should like to take the opportunity to own up to an error in *Fig.* 6 of my original paper, although this was not included in your abstract. The wrong drawing crept in here—one that applies to a different tension-ratio from that used in the data. This figure has been redrawn, and corrected reprints of the article are available. I shall be glad to send a copy, while they last, to anyone who may request it.

—R. R. Tatnall,
J. E. Rhoads & Sons.

Eliminating Speed Variations

To the Editor:

ON PAGE 48 of the August Machine Design, under "Noteworthy Patents," you included a description of a moving stairway which includes a compensating device for the variation of speed that takes place when using a chain and sprocket. This speed variation is especially noticeable when using a chain having a comparatively long pitch and sprockets of few teeth. The oldest type of compensating device is probably the use of a geared drive using a pinion bored off center with an undulating gear, the ratio between gear and pinion being the same as the number of teeth in the sprocket.

One of the main criticisms of all these devices is that they are often used with an incorrect number of teeth in the driven sprocket. In the case shown, this device with five teeth in the sprocket and an angle of wrap of 180 degrees will give a constant speed to the chain coming on the sprocket, but will double the amount of pulsation in the chain leaving the sprocket. This increased pulsation must be smoothed out in the return run of chain, but the questions are —How? and Where?

The use of an even number of sprocket teeth

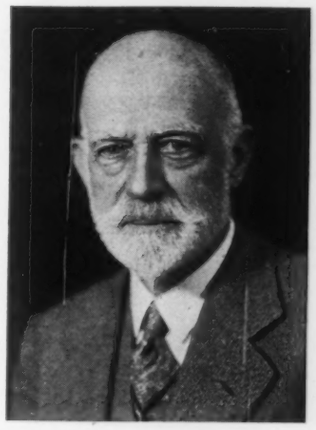
(*Concluded on Page* 76)

MEN of MACHINES

FOR notable achievement as a pioneer in laboratory research and the theory of aeronautics, Dr. William F. Durand has been awarded the Daniel Guggenheim medal for 1935. He is professor emeritus of mechanical engineering at Stanford university.

Graduated from the United States naval academy in 1880, Dr. Durand obtained the degree of doctor of philosophy from Lafayette college in 1888. An honorary doctor of laws degree was conferred upon him by University of California in 1927.

Dr. Durand was one of the first to engage in scientific research in aeronautics on his own initiative, conducting a long series of investigations on propellers. He is a past president of the American Society of Mechanical Engineers.



WILLIAM F. DURAND

• • •

MANAGEMENT of the West Lynn works of General Electric now is under Nelson J. Darling. He is a Cornell graduate, having completed courses in mechanical and electrical engineering. Toronto was his birthplace, in 1884.

At General Electric he served in the railroad engineering department in Schenectady until his transfer to Erie, Pa., where during the World war he was closely identified with designing machines for the manufacture of turbines for U. S. navy destroyers, shells, gas-electric cars and electric locomotives.

After serving as manager at Erie, Mr. Darling was appointed manager of the River Works at Lynn, Mass., in 1922, continuing his interest and activity in mechanical design. This post he still holds along with his new office at West Lynn.

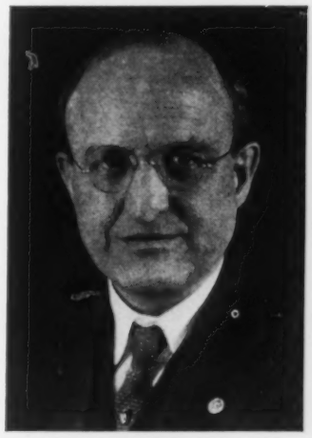
NELSON J. DARLING

• • •

AT THE recent A.S.T.M. meeting in Detroit the Marburg lecturer was Dr. L. B. Tuckerman, principal scientist and assistant chief, division of mechanics and sound, National Bureau of Standards. His subject covered "Aircraft: Materials and Testing."

A native of West Mansfield, O., he was graduated with honors from Western Reserve university in 1901. After taking graduate work in physics at University of Nebraska, he studied at the University of Berlin. In 1921 he obtained his Ph.D. degree at Johns Hopkins.

He was for a time assistant in physics, Ohio State university, and until 1919 was successively instructor, associate professor and professor of physics at the University of Nebraska. A member



L. B. TUCKERMAN

of the American Society for Testing Materials since 1922, Dr. Tuckerman has taken part in various phases of committee work. Under the National Advisory committee for Aeronautics he has been a member of the subcommittee on aircraft structures since 1931. He was active on the special committees on design of the ZR-1 airship (SHENANDOAH) and the army semi-rigid airship RS-1.

♦ ♦ ♦

DR. JEROME C. HUNSAKER, head of the aeronautical and mechanical engineering departments at Massachusetts Institute of Technology, has become technical adviser to the United Aircraft Mfg. Corp.

♦ ♦ ♦

PETER DAVEY, 6 Varick street, New York, received a Longstreth medal from Franklin institute for inventing a portable device that quickly indicates what adjustment must be made in any rotating device, from a small motor to a large turbine, to bring it into correct balance.

♦ ♦ ♦

ALEXANDER L. FEILD, consulting engineer for Rustless Iron Corp. of America and president of Alloy Research Corp., has been appointed professor of metallurgy at Carnegie Institute of Technology.

♦ ♦ ♦

MAJ. LAWRENCE LEE ANTHES has been awarded the John A. Penton gold medal in recognition of distinguished service to the foundry industry in America.

♦ ♦ ♦

DR. DOUGLAS S. ANDERSON, Tulane university, is the new president of the Society for the Promotion of Engineering Education.

♦ ♦ ♦

L. A. PRESCOTT recently was advanced to the post of vice president in charge of the engineering division of Blaw-Knox Co., Blawnox, Pa.

♦ ♦ ♦

P. J. POTTER, formerly second vice president of Pangborn Corp., has been elected a director and vice president and will be directly responsible for engineering, sales and production.

♦ ♦ ♦

SIR ROBERT HADFIELD, Bart. F.R.S., was presented with the Albert medal for 1935 by the Royal Society of Arts, London, England, for his researches in metallurgy and his services to the steel industry.

♦ ♦ ♦

JOSEPH ALLEN JOHNSON, member of the electrical standards committee of the American Standards association, was the recipient of honorary degree of doctor of engineering at the annual commencement of Worcester Polytechnic institute.

♦ ♦ ♦

W. H. SHORTT, Exeter, England, and F. HOPE-JONES, London, England, have received Wetherell medals from the Franklin institute in consideration of their respective contributions to the invention, development and production of a free pendulum type of clock of remarkable precision which now is used in standard time control in Great Britain and the United States.

♦ ♦ ♦

DR. EVERETT P. PARTRIDGE recently was appointed director of research of Hall Laboratories Inc., Pittsburgh.

♦ ♦ ♦

DR. WILLIAM E. WICKENDEN, president of Case School of Applied Science, received the Lamme medal recently for distinguished achievement in engineering education. Award was made by the Society for the Promotion of Engineering education at its convention in Atlanta recently.

Obituaries

JOHN R. TILLMAN, assistant to the vice president in charge of engineering, Bullard Co., Bridgeport, Conn., died in Cleveland Sept. 17. He was attending the machine tool show in that city. For a number of years Mr. Tillman was head of the tool engineering department of his company and since April had served in his new capacity as assistant to D. B. Bullard. A heart ailment caused his death.

♦ ♦ ♦

CHARLES R. PRATT, consulting engineer and designer of the first electric elevator, died in Montclair, N. J., Sept. 3.

♦ ♦ ♦

HENRY G. DILL, designer and engineer for Arthur G. McKee & Co., Cleveland, since 1916, died in Cleveland Sept. 6.

♦ ♦ ♦

THOMAS A. EDISON JR., eldest son of the late inventor and in charge of research engineering of Thomas A. Edison Inc., died in Springfield, Mass., recently at the age of 59. He had taken out many patents.

♦ ♦ ♦

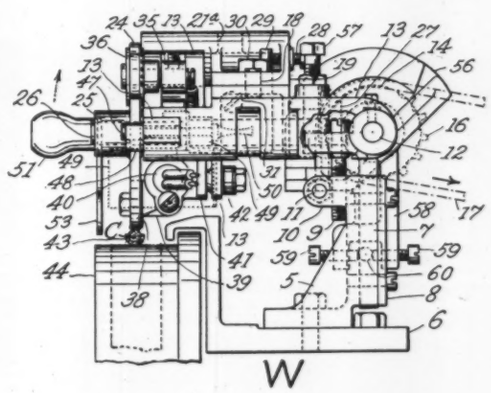
HARRY E. STITT, former chief engineer and recently consulting engineer for the Austin Co., Cleveland, died recently. He was credited with having originated the principle of standardized unit construction for modern industrial buildings. He also pioneered in the application of welding to industrial construction.

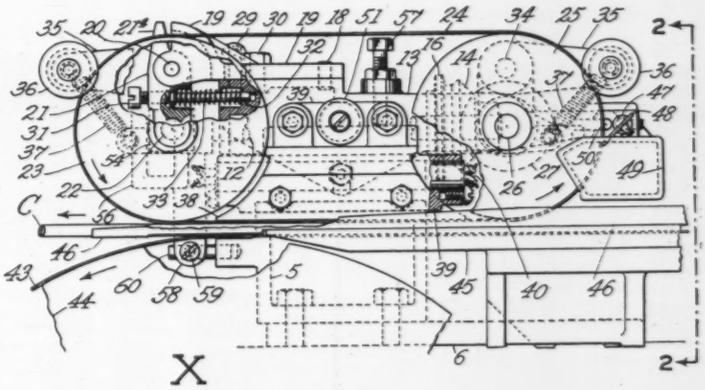
Noteworthy Patents

AN ENDLESS belt type sealer for continuous rod cigarette machines is covered by a new patent assigned to American Machine & Foundry Co. The inventor is Elberon D. Smith. Forming tape 43, *Fig.* 1 *X*, is guided through the sealer with the cigarette rod *C* by a channeled rod-forming plate 45 and the side guides 46. Sealing band 24, drawing *Y*, is heated by a heater shoe 38 attached to housing 39 of an electric heater, drawing *X*.

Since band 24 is made sufficiently narrower than the cigarette rod to go between the upstanding edges of the forming tape 43, the edges of the tape will not be scorched by the heated sealing belt. With this arrangement the margins of the forming tape are held in contact with the cigarette rod by guides 46 throughout the length of the sealer, thus assuring greater traction on the cigarette rod than is attainable with prior sealers of the endless belt type.

Handle 51, *Fig.* 1 *W*, may be grasped to swing frame 13 about shaft 12 to lift the sealer off the cigarette rod. In so doing cam follower 54, drawing *Y*, mounted on shaft 22 and covered with leather pad 55, engages with a stationary cam rail 56 and thereby swings arm 21 about pivot shaft 20. Pulley 23 then is moved sufficiently toward pulley 25 to cause band 24 to buckle away from heater shoe 38 to keep it cool while the sealer is not in use. The actuating





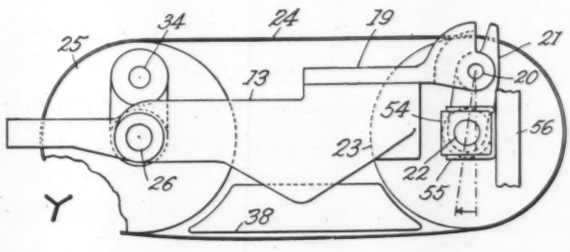


Fig. 1—The cigarette sealing belt is driven by pinch rollers that serve to dispense with the necessity of flanges on the pulleys to retain the belt. Flanges might interfere with the cigarette rod

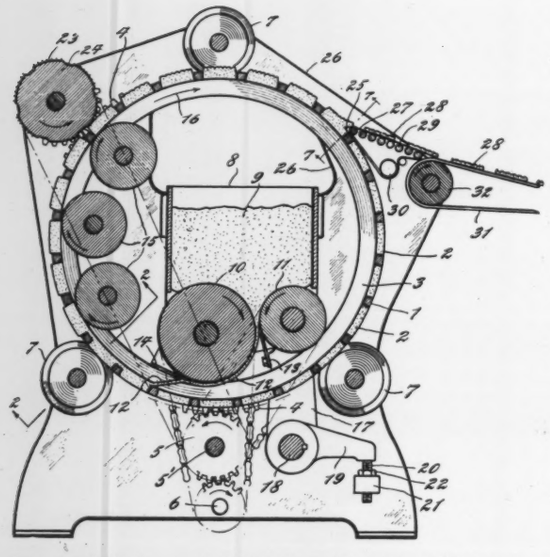


Fig. 2—Plastic material forced through orifices of a hollow cylinder is shaped by dies on a roll

surface of the cam rail 56 is serrated so that it acts as a brake on cam follower 54 when replacing the sealer on the cigarette rod.

Number of the patent is 1,992,723.

FORMING of articles of plastic materials such as baker's dough is accomplished by a machine, *Fig.* 2, recently patented, that embodies a unique processing idea, even though the mechanism employed appears involved in comparison with a simple printing or stamping device. Dough 9 passes from hopper 8 to a pair of rolls 10 and 11, so spaced as to form a layer or sheet 12. This layer is stripped from roll 11 by stripper 13 and from roll 10 by stripper 14, after which it passes into contact with the inside face of the wall of cylinder 1. Subsequently the dough is gradually forced into orifices 2 by passing between the wall of the cylinder and the row of rolls 15. Eventually, each orifice will contain a mass of dough which will be forced through it as the thickness of the layer increases, and project from the outer side of the wall, this wall forming the mold for the material.

As the cylinder rotates and as the masses of dough protrude further from the orifices, they come in contact with printing dies 23 formed on the periphery of a roll 24. The printing dies co-operate with one of the rolls 15, shown in *Fig.* 2 as the uppermost one, to imprint a desired shape on the dough. After leaving the printing dies the projecting parts of the masses of dough may be sliced off as by a stationary knife 25. A belt conveyor may be provided closely adjacent the knife and in position to receive the sliced off parts 28 as they come from the mold.

Irwin Elliott is the inventor of the method and mechanism. His patent No. 2,001,243, is assigned to Universal Oven Co. Inc., New York.

ONE of the features of a new invention for supplying polishing material such as rouge, to machines for polishing plate glass is an electrically-operated valve that again calls attention to the increased use of solenoids. During operation of the mechanism, *Fig.* 3, when solenoid 36 is de-energized, spring 47 will act to urge arm 24 outwardly so as to rock it about its pivot to the position shown by the broken lines in the drawing. In this position the valve head 29, which is integral with arm 24, will be moved inward and upward, and the compressing member 30, engaging rubber liner 22, will function to compress it to prevent passage of polishing medium. As shown, the body portion 25 of arm 24 carries or has formed integral therewith a foot 28 provided at its inner end with valve head 29. This valve head is formed with an undercut groove in which is secured resilient compressing member or pad 30 formed of soft rubber.

Upon energization of the solenoid 36, however, plunger 38 will be drawn inwardly so as to rock arm 24 in the opposite direction against action of spring 47. When this is done the compressing member 30 will, of course, be moved outwardly or away from member 35 so as to effect the opening of the liner 22 and permit passage of polishing liquid to the machine.

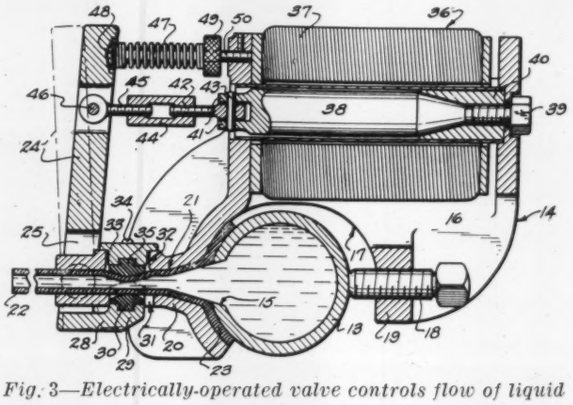
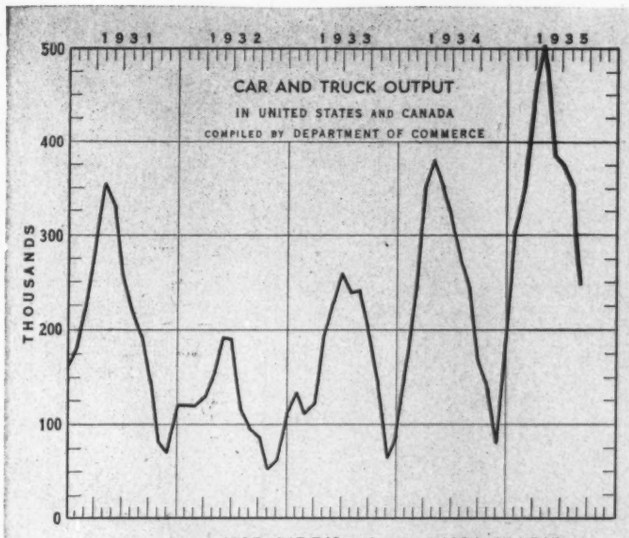


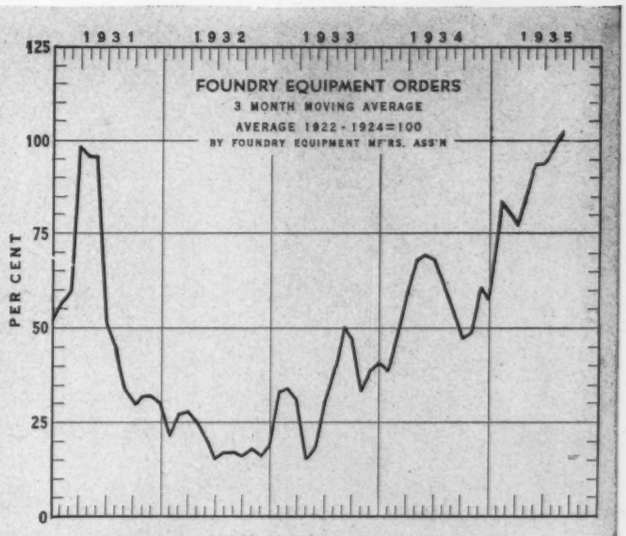
Fig. 3—Electrically-operated valve controls flow of liquid rouge to machines for polishing plate glass

Joseph P. Crowley is the recipient of the patent which is assigned to Libbey-Owens-Ford Glass Co., Toledo, O. It is designated No. 2,006,196.

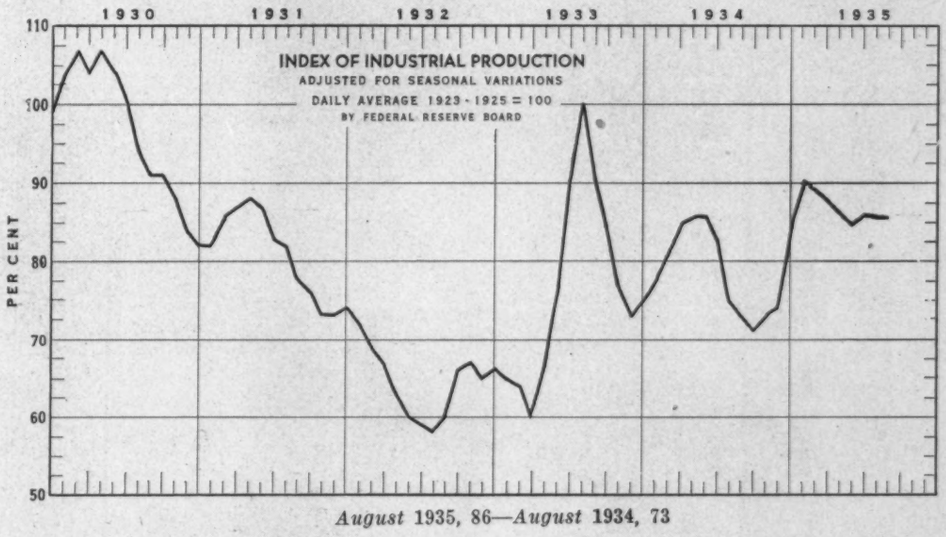
How is Business?



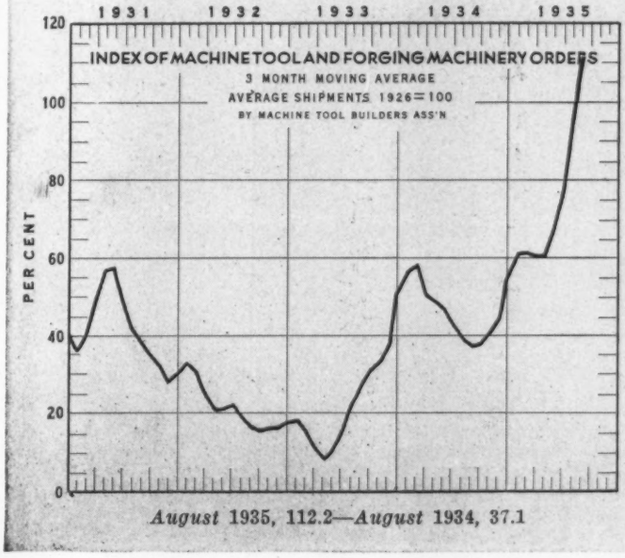
August 1935, 247,743—*August* 1934, 244,715



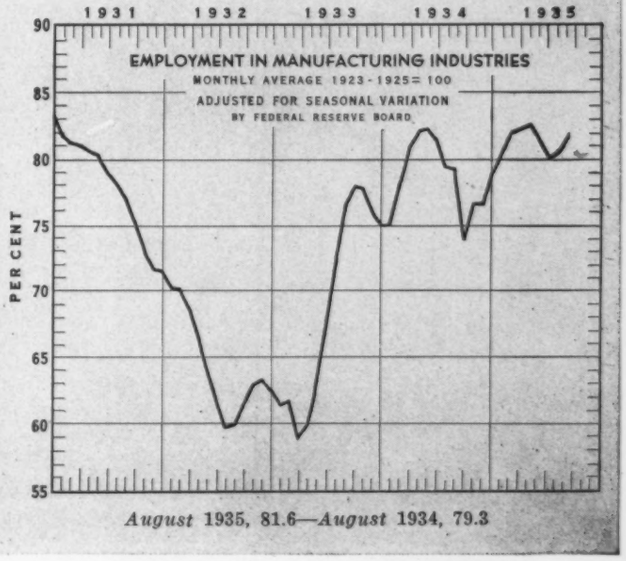
August 1935, 102.4—*August* 1934, 54.7



August 1935, 86—*August* 1934, 73



August 1935, 112.2—*August* 1934, 37.1



August 1935, 81.6—*August* 1934, 79.3

Topics . . .

AT THE moment probably the most timely subject is the improved outlook in business. One of the best signs of returning confidence is the fact that only twenty-four of the nation's hundreds of industries have taken advantage of the opportunity to apply for so-called codes under the protecting arm of the Federal Trade commission which succeeded the late NRA as code maker. This condition becomes even more impressive when it is considered that under the old NRA over 550 industries were coded and that there were something like 200 additional supplemental trade agreements.

While it is true that more than 100 other industries have inquired of the commission regarding codes, most of these inquiries are believed to be purely perfunctory. For the most part it is believed the possibility of further NRA legislation and the stringency of existing laws cause most industries to hold off, pending developments.

Apparent unwillingness of industry again to submit to regimentation and control reflects the returning confidence of business men in their ability to carry on without artificial checks on economic law.

• • •

Eyes of the medical world have been turned on a robot heart designed by Col. Charles A. Lindbergh. This new instrument has been accepted as a boon to medical research. Col Lindbergh worked with Dr. Alexis Carrel in the development of the heart at Rockefeller institute. The perfusion pump, as it is technically called, is made entirely of glass.

• • •

Likening the street railway industry to a manufacturer whose tools were obsolete and whose products were antiquated, H. L. Andrews, General Electric vice president, told the American Transit association recently that its obligation to investors and public could be discharged only when it delivered a modern "transportation product" unequalled by any other medium. He recommended the purchase of modern light weight, low cost rail cars and electric coaches, or trackless trolleys, of standard design.

• • •

A supercharged Duesenberg special speedster recently set up a new record of 135.47 miles an hour for a twenty-four hour run. It surpassed the former record of 134.85 miles an hour made by 700-horsepower Napier racer. Horsepower of the Duesenberg was 325. Reference to supercharging brings to mind the fact that Cord will offer a supercharged line of cars.

• • •

Reports from the United States Consul, Birmingham, England, indicate that a new process for welding light aluminum alloys such as RR 56 and duraluminum has been perfected in Great Britain. The welding material is "alusol."

• • •

Recently work was started by Charles Nicholson on the design of ENDEAVOUR II which T. O. M. Sopwith is building as a challenger for the America's cup in 1937. His greatest problem lies in developing a design that will produce greater speed despite an increase in the size of the craft with the same sail area, 7560 square feet, as was used on the ENDEAVOUR which met defeat.

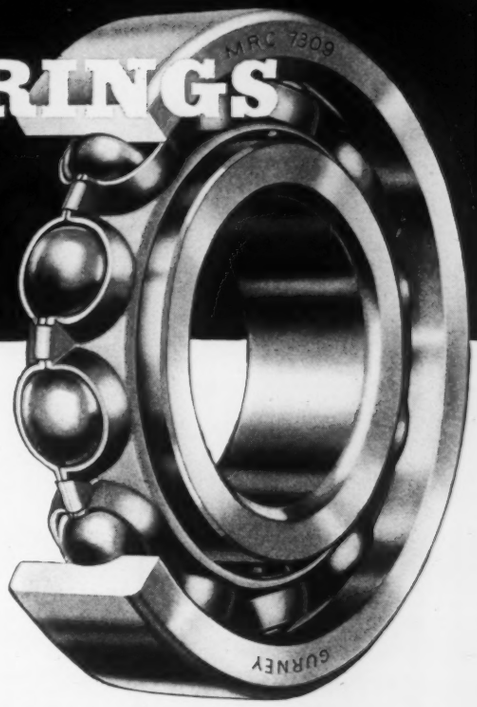
• • •

Science and inventiton lately have added groups to the stock list that would have astonished the trade of thirty-five years ago, says the *New York Times*. Some of the new classifications are: Air conditioning, diesel, artificial silk, electrical appliance, fabricated houses, aircraft, industrial alcohol and plastics.

M·R·C

BALL BEARINGS

(23 TYPES)



THERE are a score or more of bearing types. Each possesses individual characteristics to fit a specific operating condition. Maximum efficiency and economy can be had only when the correct bearing is selected and applied.

The M-R-C line offers a choice of 23 types . . . including many original designs developed by M-R-C Engineers to handle unusual bearing problems of machine and equipment manufacturers.

With such a complete line from which to choose, and with M-R-C Engineering Service to help you, it is a simple matter to select the correct bearing for every application.

Leadership

M-R-C Strom SRB GURNEY BALL BEARINGS

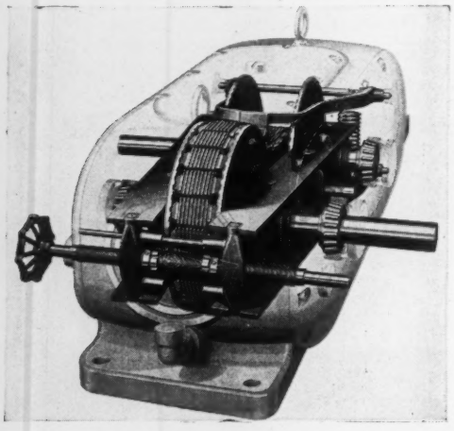
MARLIN-ROCKWELL CORPORATION

Executive Offices—Jamestown, N. Y. Factories: Jamestown—Plainville, Conn.—Chicago

NEW
Materials and Parts

Adds New Transmission Models

IN ORDER to increase the range and flexibility of P.I.V. gear variable speed transmissions, Link-Belt Co., 2045 West Hunting Park avenue, Philadelphia, has made available an entire line which can be furnished in the following combinations and sizes: Motorized (when desired) with motor forming an integral part of the unit; with or without speed reduction gearing; with



Infinitely variable speed transmission can be furnished with horizontal or vertical box

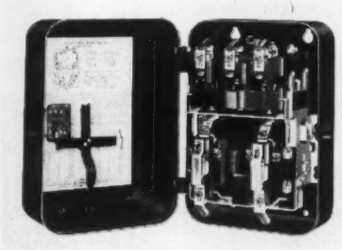
horizontal or vertical box; and in five sizes up to 15 horsepower capacity. Previously the transmissions were available in sizes up to 10 horsepower, with horizontal box only, and without reduction gear sets or the integral-motor feature. Motorized construction aids in achieving a compact drive. The operating principle of the basic unit remains the same.

Announces Stainless Welding Rod

INTENDED for welding chrome-nickel steels of the 18-8 type, a new stainless steel welding rod has been introduced by Linde Air Products Co., 30 East Forty-second street, New York. Specification of the use of this rod, known as Oxweld No. 28, Columbium-Treated 18-8 welding rod, enables a simplification of the fabrication of parts from 18-8 stainless steel and insures greater corrosion resistance of the fabricated joint areas.

Develops Improved Overload Relay

FEATURING a new temperature overload relay designed on the melting alloy principle in which greater accuracy is obtained by total enclosure of the relay in a molded case, a new across-the-line motor starter for general purpose installations has been announced by Condit Electrical Mfg. Corp., Boston. The new starter, designated type A-32, is rated at 25 horsepower



Extra heavy silver contacts, vertical make and break, are included in new motor starter

at 440 and 550 volts, 15 horsepower at 220 volts, and 7½ horsepower at 110 volts, and is furnished for pushbutton (remote) control. Extra heavy silver contacts, vertical make and break, are included in the controls which have a short-stroke mechanism and multibreak arc-prevention principle. Undervoltage is also provided.

Stainless Tubing Is Introduced

THIN wall stainless tubing without or with carbon steel inserts which are fabricated into the tube when applications demand addi-

PRECISION BEARINGS
in 108 distinct series

To the machinery world, NORMA-HOFFMANN offers the most complete and comprehensive line of anti-friction bearings in America—108 distinct series—a PRECISION Bearing for every load, speed and duty.

Many of these have been pioneered, or specially developed, by NORMA-HOFFMANN engineers to meet specific requirements as revealed by advancing methods in machine design, manufacture and operation.

In times past, engineers often had to adapt their designs to the comparatively few standard bearing types then available. Today—with the wide range of types and sizes afforded by the standard NORMA-HOFFMANN PRECISION line, such compromise is seldom necessary.

In the 108 PRECISION Series are included: ball, roller, needle and thrust bearings; open, closed, and angular contact bearings; radial and self-aligning types; single and double row types; felt-protected, shielded, snap ring and self-sealed types. The size range is from 1/8- to 21-inch bore, embracing both metric and inch sizes. PRECISION Ball and Roller Bearing Pillow Blocks are also available in an extensive range of sizes.

Write for the Catalog. Let our engineers work with yours.

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PRECISION BEARINGS

BALL. ROLLER AND THRUST

NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN. U.S.A.

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SPECIAL ROLLED SECTIONS

THE example shown here, one of the innumerable special sections that have been rolled by Bethlehem, suggests the latent possibilities in this method of parts manufacture.

The wide range of shapes, sizes and physical properties that are available in special rolled sections provide almost unlimited opportunity for the rapid, economical production of intricate parts. The chances are that a careful survey of your product, piece by piece, will disclose places where this method of manufacture could be applied with profit.

Let Bethlehem engineers cooperate with you in applying to your products the economies of manufacture from special rolled sections.

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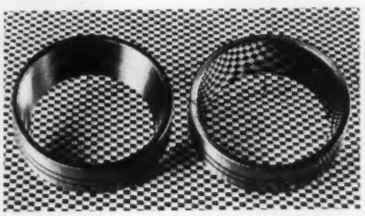
General Offices: **Bethlehem, Pa.**

Bethlehem District Offices are located at **Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Houston, Indianapolis, Kansas City, Milwaukee, New York, Philadelphia, Pittsburgh, San Antonio, St. Louis, St. Paul, Washington, Wilkes-Barre, York.** ***Pacific Coast Distributor:*** **Pacific Coast Steel Corporation, San Francisco, Seattle, Los Angeles, Portland, Salt Lake City, Honolulu.** ***Export Distributor:*** **Bethlehem Steel Export Corporation, New York.**

tional strength and rigidity, has been made available as metal architectural tubing by Allegheny Steel Corp., Brackenridge, Pa. The available O. D. sizes include ⅝, ¾, ⅞, 1, 1¼, 1½, and 1.9 inches. Certain sizes of square and rectangular shapes also will be produced.

Bearings Have Mirror Finish

DEVELOPMENT of a new mirror finish designed to give longer life, quieter operation, the minimum of internal friction and increased efficiency of lubrication in tapered roller bearings has been announced by Timken



New mirror finish is applied to tapered roller bearings

Roller Bearing Co., Canton, O. This new finish, as can be seen from the accompanying illustration, is much smoother than the standard ground surface, and is being applied to all sizes of the company's bearings as rapidly as the special equipment required can be built and installed.

Time Switches Control Operations

AUTOMATIC time switches which will control almost any electric circuit on a schedule related to the time of day are a recent development of General Electric Co., Schenectady, N. Y. The Type T-17 and Type T-27 switches, shown herewith, will perform any practical number of operations per day and can be set to skip one

Switch is operated by small riders clamped to the periphery of the time dial at selected points by means of thumb screws

STANDARD OF COMPARISON

When draftsmen, engineers or architects compare tracing papers or vellums, they invariably say, "It's something like Dietzgen's *Nelson*" or "... like Dietzgen's *Edvell*" or "... similar to Dietzgen's *Eton*". Leadership so widely recognized must be rooted in reality. Just the fact that others are compared to Dietzgen *must* indicate the chance you take when you accept other than the genuine. If you have not already done so, send for the Dietzgen Sample Books of Tracing Papers and Vellums. Note the unparalleled wide array of surfaces, weights and characteristics Dietzgen offers. Try them ... for "tooth"... for erasing... for transparency... for anything you wish. One of them will come nearer *your* idea of perfection than anything you have ever used. Then you, too, will see why Dietzgen is the standard of comparison.

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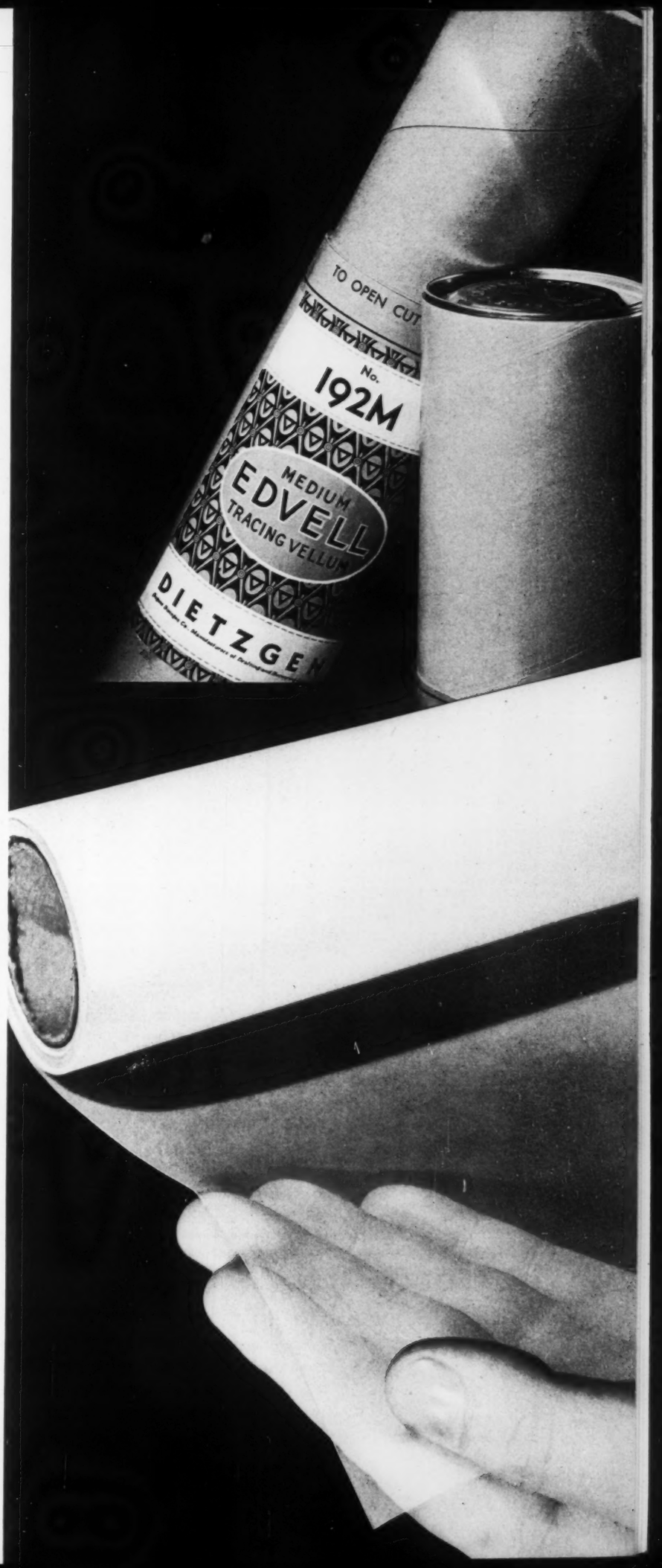

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GOOD LOOKING

... and it can take it

In Master Motors you get the plus value of pleasing symmetrical appearance which makes them an attractive addition to any machine. Of course, underneath the good looks they have the heavy duty construction, the built-in stamina that makes it possible for them to stand up and take it. Rugged semi-enclosed frames, oversize shafts, extra large bearings, specially insulated windings . . . all mean added years of satisfaction on even the hardest jobs. Get what you pay for in motor stamina and motor performance . . . and the added value of attractive appearance. Call a Master Engineer.

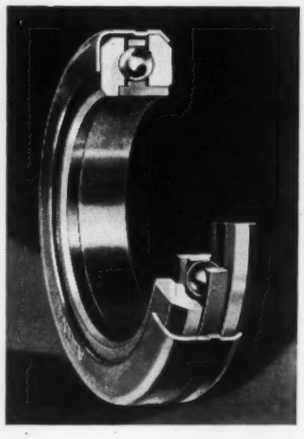
THE MASTER ELECTRIC COMPANY
DAYTON OHIO U S A

or more days if desired. Standard units are designed for alternating current circuits, 115 and 230 volts. Current rating is 40 amperes per contact.

The switch is operated by small riders clamped to the periphery of the time dial at selected points by means of thumb screws. These riders, any number of which can be used, within limits, engage the tripping lever of the switch. The switch itself consists of a ratchet-operated cam which is actuated by an operating spring and alternately forces the contact buttons apart and allows them to close. Drive is direct from a Telechron motor through a spur gear train.

Bearings Are Lubricated for Life

CLUTCH release ball bearings in a new design, made for modern speeds and heavy loads, known as the "T" type are a recent development of Aetna Ball Bearing Mfg. Co., 7310 Woodward avenue, Detroit. The bearing, shown herewith, is lubricated for the life of the vehicle in which it is used. It is made with an oil impregnated bronze ball retainer and packed with lubricant. The special bronze ball retainer enables quietness in operation, while the construction of this retainer provides for keeping the races in true pitch line at all times.



Bearing is made with an oil-impregnated bronze ball retainer and is packed with lubricant

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Provides New High Strength Steel

COLD finished steel known as Speed Case, manufactured by Monarch Steel Corp., Indianapolis, is now available in all bar sizes up to 3½ inch round. The material is a new steel in the high-sulphur, high-manganese group, with properties, it is stated, which exceed the older steels in this general classification.

Speed case is an open-hearth steel containing

Cross-section of Vari-Pitch Sheave and Texrope Belt adjusted for minimum diameter—high speed.

Cross-section of Vari-Pitch Sheave and Texrope Belt adjusted for maximum diameter—low speed.

THE NEW Vari-Pitch TEXROPE SHEAVE

o The new Vari-Pitch Texrope Sheave, now offered by the Allis-Chalmers Mfg. Co., represents a vitally important development in power transmission. ● By a simple adjustment, which takes but a few moments, the diameter of this new sheave can be altered so as to give a variation in speed of from 15 to 25 per cent per sheave; if both sheaves are of this type a 30 to 50 per cent variation in speed is possible. This permits you to take advantage of higher speed cutting tools; it permits you to experiment with different speeds to ascertain at just what speed your machines show the greatest efficiency; it permits you to make different products, some of which require higher speeds and some lower — and do all this without dismantling and buying new drives, but simply by taking a few moments to make the desired adjustment. ● Vari-Pitch Texrope Sheaves are for manual and automatic adjustment. The manual type is recommended for applications that require occasional changes of speed. For applications that require frequent changes the entirely automatic type is recommended in which speed can be instantly varied to full range while the drive is in operation.

TEXROPE DRIVES

ORIGINATED BY ALLIS-CHALMERS

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Milpaco Oil Seals rank with the outstanding achievements of 1935. Characteristic design and construction establish them as unusual.

Details of design and construction in Milpaco Oil Seals—some very minute—make them more effective sealing and protective units, and give them longer life in active service.

Exact chemical and physical processes applied for every kind of application, qualify Milpaco Oil Seals for specific conditions.

Intensive research, laboratory and field tests, have disclosed some mighty interesting facts about Milpaco Oil Seals in Every Type of Industry

Our technically trained engineers have an unusual amount of scientific knowledge on the subject of oil seals and applications, at their command.

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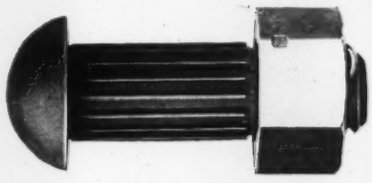
approximately 0.20 per cent carbon and combines high strength with free machinability and special adaptability for carburizing. Its average tensile strength is in excess of 70,000 pounds per square inch in the hot rolled state and in excess of 85,000 pounds per square inch in the cold drawn state. The average yield point in the hot rolled state is 52,000 pounds and in the cold drawn state 75,000 to 80,000 pounds. Percentage of elongation is 26 per cent as cold drawn and 37.5 in as rolled, hot rolled condition. Brinell hardness in hot rolled is 131 to 137 and from 150 to 156 in cold drawn. Izod impact values on the new steel average from 60 to 80 foot pounds.

Rib Bolts Are Firmly Locked

STRUCTURAL rib bolts for use with all types of plate work in conjunction with locking nuts are a recent development of Automatic Nut Co., Chrysler building, New York. Ribs of the bolt, made from carbon-manganese steel with a minimum tensile strength of 70,000 pounds per square inch, embed themselves in the wall of the work to insure a tight fit. The bolt, shown herewith, has United States standard thread, and is made either black or galvanized. The only equipment necessary for use of the bolt is a hand hammer and wrench. It is available in all sizes and lengths.



Rib bolts embed themselves in the material, insuring a tight fit, and are locked by automatic nuts

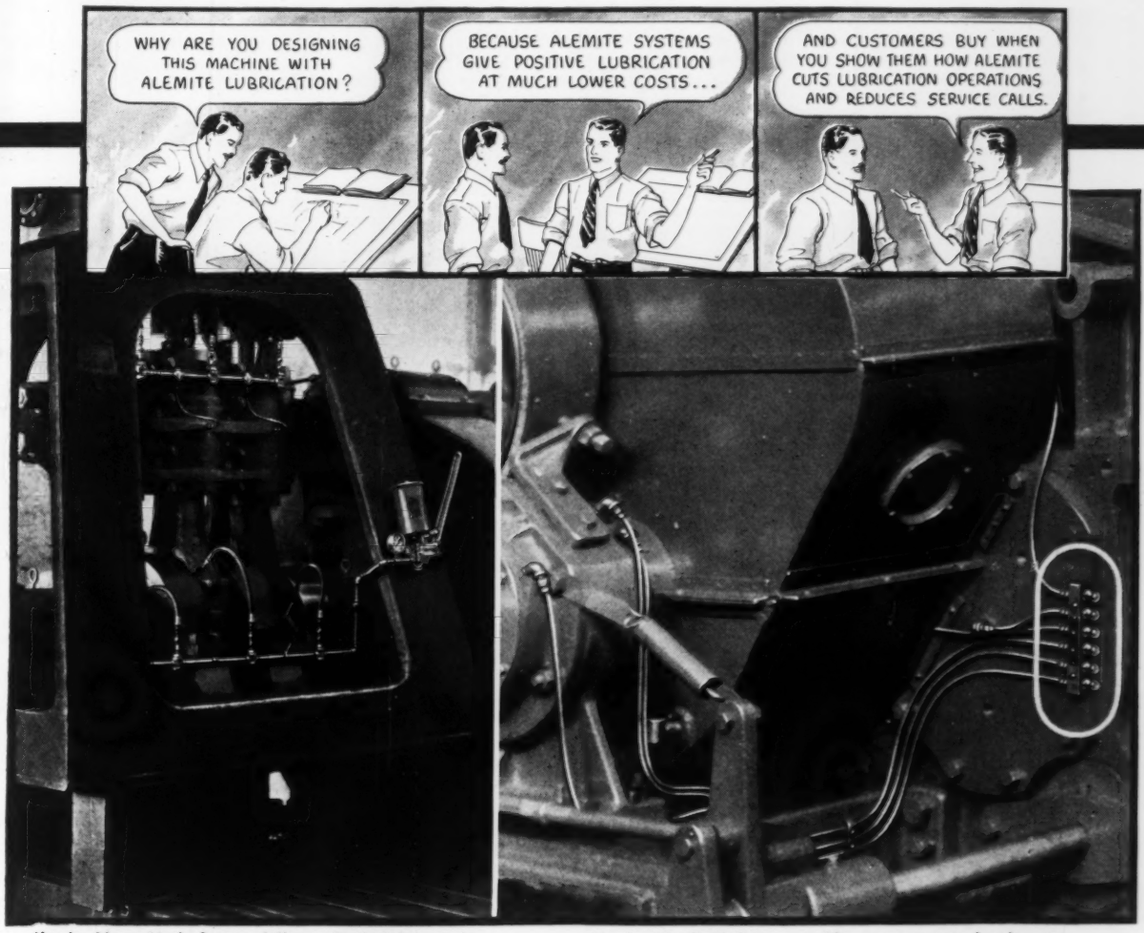
Contactors Interrupt the Arc

IDEAL for machine tool applications, a new line of 15 and 25 ampere contactors utilizing the De-ion principle of arc interruption have been announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The contactors are compact and permit efficient utilization of machine space. Confinement of the arc within the De-ionizing chamber permits a compact design that is desirable for built-in applications. A shock-proof vertical lift solenoid prevents closing due to tilting, sudden jolts or bumping.

Operation of the contactor depends on the principle that the thin layer of air immediately adjacent to cold cathodes will withstand about

DESIGN YOUR MACHINES FOR ALEMITE LUBRICATION

—*The System Experienced Customers Specify!*


WHY ARE YOU DESIGNING THIS MACHINE WITH ALEMITE LUBRICATION?
BECAUSE ALEMITE SYSTEMS GIVE POSITIVE LUBRICATION AT MUCH LOWER COSTS...
AND CUSTOMERS BUY WHEN YOU SHOW THEM HOW ALEMITE CUTS LUBRICATION OPERATIONS AND REDUCES SERVICE CALLS.

Alemite Metro-Matic System delivers plastic lubricant in predetermined quantities to any number of bearings from one point, with one operation.

Alemite Manifold System enables many remote bearings to be lubricated from one point. 24 separate bearings are lubricated from 7 similar stations.

● On food-making machines and heavy, high-pressure pumps—on conveyors and power shovels, wherever shafts spin on bearings, Alemite provides positive, low-cost lubrication.

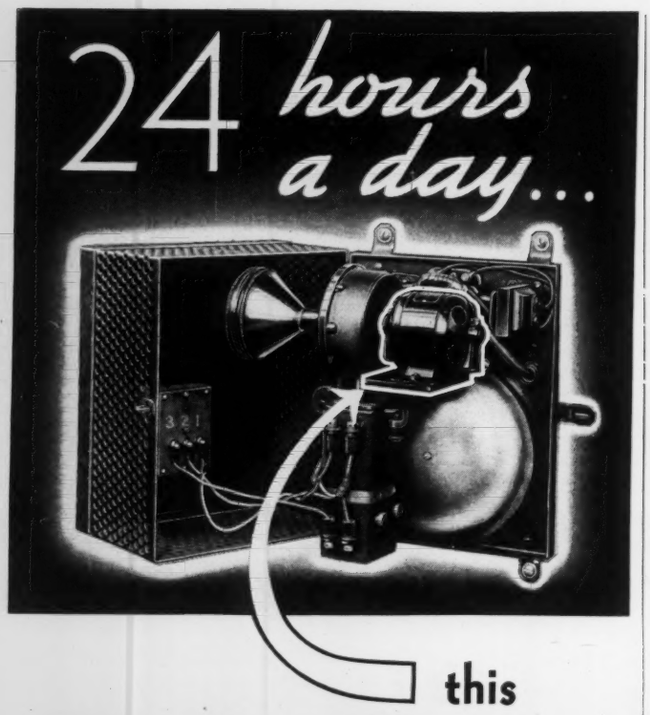
Machinery users in every industrial field are specifying Alemite Lubrication. For Alemite cuts maintenance costs by reducing service calls and lubrication operations, saves lubricant, and reduces contamination to a minimum. They have found they can put their trust in the *thoroughness* of Alemite Lubrication. So why not design your machines right from the start with this lubrication system experienced manufacturers specify?

The machines illustrated show two of the many ways Alemite solves lubrication problems. There are Alemite Systems for every lubrication need.

You'll find it worth while to send in for Alemite's *free* book on fittings and hand guns.

ALEMITE—*A Division of Stewart-Warner Corporation*
1890 Diversey Parkway Chicago, Illinois

ALEMITE *Controlled Lubrication*



this

Bodine Motor protects workers from *carbon monoxide poisoning!* • • • •

● When human life is endangered by high carbon monoxide concentration in the atmospheres of chemical plants, garages, etc., this MSA Carbon Monoxide Alarm gives a prompt, loud warning. Often the alarm must give protection 24 hours a day, and the motor must operate continuously without a shutdown. Naturally, the Mine Safety Appliance Co. sought a driving motor of the utmost reliability. They chose a Bodine!

Hundreds of other special machines are being driven by Bodine fractional horsepower motors. The Bodine line includes motors of every type, from 1/500 to 1/4 H. P. For thirty years Bodine engineers have specialized in engineering these motors for special jobs. They can help you solve your motor drive problem. Write today. Bodine Electric Co., 2258 W. Ohio St., Chicago, Ill.

BODINE

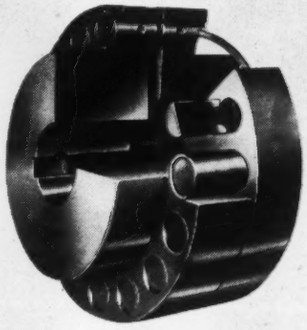
BODINE FRACTIONAL H. P. MOTORS

ENGINEERED FOR YOUR PRODUCT

250 volts before breaking down, and, after having been subjected to an arc, de-ionizes rapidly and acquires the ability to withstand this voltage again very quickly. When the contacts separate, the arc is instantly forced into the grid chamber and, as the current passes through the zero point of the cycle, the air between the plates is almost instantly de-ionized and the arc extinguished.

Couplings Employ Alloy Steel

FORGED high-manganese alloy steel is now being employed in all except the larger sizes of Francke flexible couplings being built by John Waldron Corp., New Brunswick, N. J. The larger sizes are molded of a high grade semi-steel. In order to prolong the life of the moving parts of the coupling, self-lubricating, wax-impregnated bronze bushings have replaced the old style dry bushings. The new bushings have highly polished bearing surfaces which provide a large contact area.

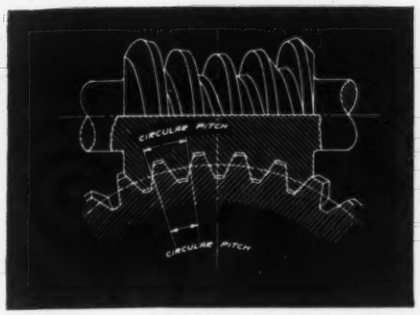


Center portion of cross pins in flexible couplings are now made glass hard

Another improvement in the couplings is in the design of the cross pins by which the crucible spring steel laminations are held within the keepers. The center portion of the cross pins which passes through the perforation in the laminations is now made glass hard. By a special process, the ends of the cross pins are expanded into the tapered recesses of the keepers, thereby making it impossible for them to come loose.

Facilitates Switch Ganging

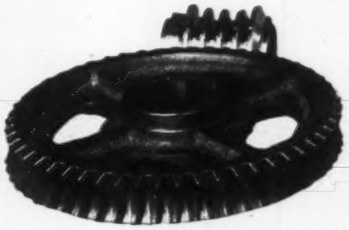
A NOVEL ganging type switch which also may be used in single installations has been announced by Square D Co., Detroit. The new switch, shown herewith, has removable side walls, secured by three screws. For ganging

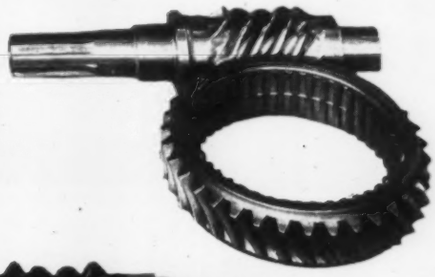


CONE AREA CONTACT PRINCIPLE WIDENS WORM GEAR APPLICATIONS

Window Regulators—*1,000,000 sets produced in 1934*

Super-Chargers—*40,000,000 miles on 3,000 cars without replacement or failure*

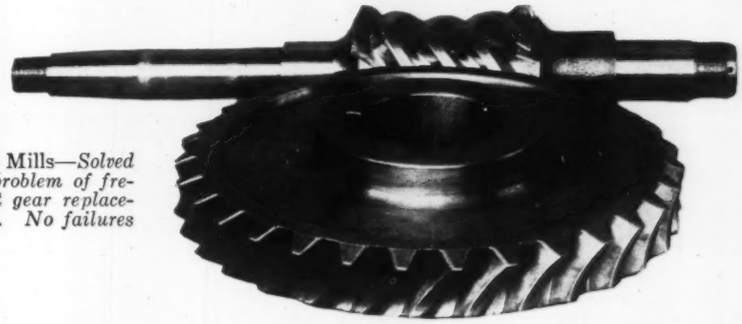




Road Grading — *Standard equipment with one of the largest producers*

Passenger Car Rear Axles—*No special lubricants required*

Bus Axles—*Adopted as standard by several large fleet operators*



Steel Mills—*Solved the problem of frequent gear replacement. No failures*

Among the numerous fields in which Cone Area-Contact Worm Gears are already being used in quantities are:

Machine tools	Aircraft engines	Steel mills	Speed reducers
Automobiles	Tractors	Stokers	Hoists
Trucks	Road graders	Ventilators	Diesel engines
Buses	Farm machinery	Ordnance (military)	Marine equipment
Airplanes	Mining machinery	Dam machinery	Brewery equipment

Area contact, one of the fundamental changes in tooth construction since gears were first produced, has brought universal acceptance to Cone Worm Gears in industry.

Already this revolutionary new form of gearing is being used in a wide variety of applications — reaching into every industry in which gears are required.

Rotating speeds as high as 30,000 r.p.m., and as low as 4 revolutions per hour; gear ratios as high as 100 to one and as low as one to one; 40,000,000 miles in 3,000 automobiles without a single failure or replacement for wear—indicate the breadth of Cone Area-Contact Worm Gear applications,in which these gears are already operating with complete success.

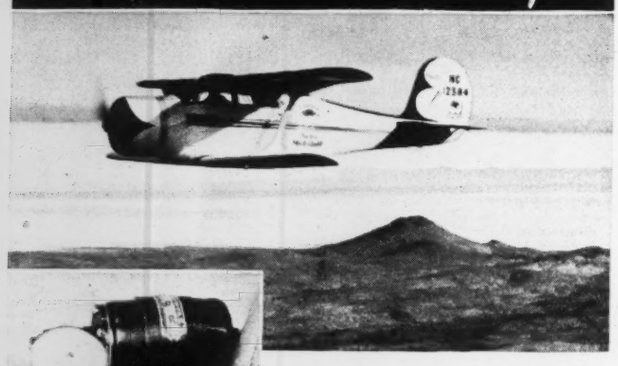
Production Problem Solved

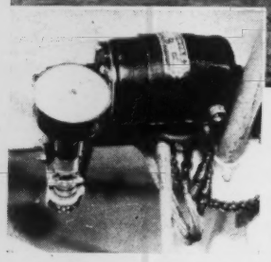
Production methods and equipment for area-contact worm gears have been developed to meet any demand—whether it be for a million sets of gears or a few dozen—whether it be for gears one inch or several feet in diameter.

Information on any phase of Cone Area-Contact Worm Gearing will be gladly supplied, whether it deal with the application of the gears themselves or with production methods and production equipment.

MICHIGAN TOOL COMPANY, DETROIT, MICHIGAN

BEECHCRAFT DEMANDED *Reliability!*





The Beech Aircraft Co., Wichita, Kansas, had what appeared to be a tough motor problem — power reliable enough to operate a retractable landing gear. Here is what the 22 years experience of Dumore Engineers accomplished — quoting Mr. T. A. Wells, Chief Engineer for the plane manufacturer: *"After receiving the motor we found that it exceeded the specifications for power so that we were able to gear the landing gear approximately three times as fast as we had expected to be able to do it. We have tested this unit thoroughly in operation with an overload on it and we have found that it functions perfectly. This motor is much lighter and more compact than any other unit now on the market and fills our requirements very satisfactorily."*

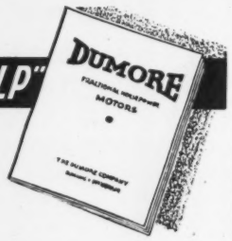
There are many sizes of Dumore precision-built (series wound) motors — in h.p. from 1/100 to 3/4; in voltages from 6 to 250; in any speed through electric governors (on 1/4 h.p. or less) and by speed reducers (on 1/6 h.p. or less). The handy Dumore catalog tells you how to obtain FREE engineering service. Mail the coupon for your copy.

DO YOU KNOW

that the Dumore Company builds a complete line of Lathe and Hand Grinders? These tools are used the world over for **precision** grinding in tool and die rooms, pattern shops and on production work.

DUMORE
FRACTIONAL HORSEPOWER
MOTORS

APPLICATION FOR "HELP"



THE DUMORE CO., Dept. 125-K
Racine, Wis.

Send me your latest catalog of Dumore fractional h. p. (series wound) motors.

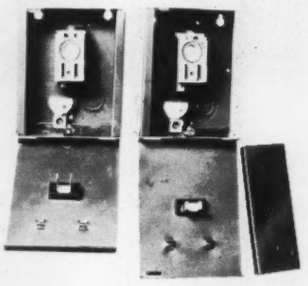
*Name*_____ *Title*_____

*Firm Name*_____

*Address*_____

*City*_____ *State*_____

purposes the side wall is removed and a connector is inserted in place of the wall, thus connecting two or more switches together. The design is such that the ganged switches take up no extra room, the switches being contiguous

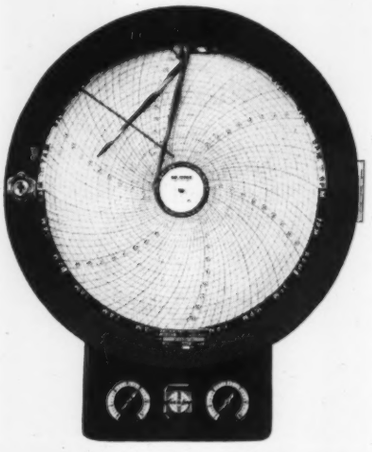


Improved switch may be used for ganging switches or as single installations

to one another. Opening the main door of the switch disconnects the circuit so that the fuses are dead when accessible. A metal trim covers the wiring and connections. The switch is available in three pole arrangements; two and three-wire solid neutral and straight two-pole.

Announces Air-Operated Controllers

AIR-OPERATED controllers in a new and complete line for recording and indicating temperature, flow, pressure and liquid level have been introduced by Brown Instrument Co., Philadelphia. The "Air-o-Line" controller, with 1 to 150 per cent throttling range and automatic reset, recognizes and corrects for the magnitude,



Operating with air devices, new line of controllers gives automatic control of production processes

rate and direction of departure from the control point. These instruments are capable of full automatic control and will maintain a process at the control point within close limits. Throttling range and automatic reset dials are instantly adjustable with a screwdriver, without removing the chart plate.

Indicating and recording thermometer-type

DEPENDABILITY

Since the inception of the automotive industry, millions of Nickel Alloy Steel parts have been used by prominent manufacturers of motor cars, trucks and busses. Their service records are eloquent testimony to the dependable service these steels render.

THE INTERNATIONAL NICKEL COMPANY, INC.

67 WALL STREET, NEW YORK, N. Y.

NICKEL ALLOY STEELS

MACHINES*

of all types are designed by Executives and Engineers who read Machine Design

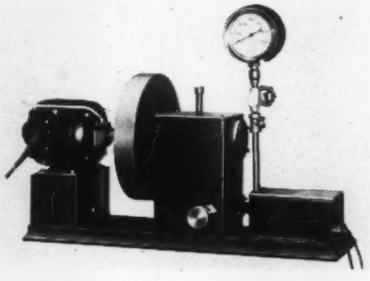
Adding machines
Addressing and mailing machines
Agricultural machinery
Aircraft
Bakers' machinery
Baling presses
Blowers and fans
Bookbinding machinery
Bottling machinery
Calculating machines
Canning machinery
Card-punching and tabulating machines
Cars and trucks
Cash registers
Cement and concrete machinery
Change making machines
Check writing machines
Clay working machinery
Clothes pressing machines
Coffee roasting and grinding machines
Condensers
Confectionery and ice cream machinery
Conveying machinery
Cotton gins
Cranes, including hoists and derricks
Dairy machinery
Dish washing machinery
Dredging and excavating machinery
Electrical machinery
Elevators and elevator machinery
Engines, steam and internal combustion
Fare registers and boxes
Flour mill and grain mill machinery
Foundry machinery
Gas machines
Gas regulators
Glass making machinery
Hat-making machinery
Hydraulic machinery
Incandescent lamp making machinery
Laundry machinery
Lawn mowers
Leather working machinery
Locomotives
Machine tools
Manifolding machines
Metal working machinery
Meters, gas and water
Mining machinery
Miscellaneous and special machinery
Motion picture cameras and projector
Motorcycles and bicycles
Motor vehicles
Oil-mill machinery
Oil-well machinery
Ore crushers
Packaging machines
Packing house machinery
Paint making machinery
Paper box machinery
Paper mill and pulp mill machinery
Pharmaceutical machinery
Photo-engraving machinery
Pneumatic machinery
Printing machinery
Pumps and pumping machinery
Refrigerating and ice making machinery
Road making machinery
Rolling mill machinery
Rubber working machinery
Scales and balances
Sewing machines
Shoe machinery
Slicing machines
Slot vending machines
Stokers, mechanical
Stone working machinery
Sugar mill machinery
Textile machinery
Tobacco manufacturing machinery
Transmission machinery
Typewriters
Vacuum cleaners
Washing machines, ironing machines
Welding machines
Well-drilling machinery
Windmills and towers
Woodworking machinery

***Machines as classified by the United States Census Bureau**

temperature controllers are available for temperatures within limits of minus 40 and plus 1200 degrees Fahr. Potentiometer-type controllers operate within limits of minus 300 and plus 3400 degrees Fahr. Two types of flow controllers and liquid level controllers are also offered: The inductance bridge type and the mechanical type. The remote operating characteristics of the electric flow meter and the flexibility of the air-operated control are combined in one controller.

Flywheel Is Utilized by Pump

DESIGNED on a new principle, employing a flywheel as for a punch press, a new hydraulic pump has recently been brought out by Hydro-Motive Co., 1001 West Washington boulevard, Chicago. In the design a direct-connected 1200 RPM motor drives a crankshaft and flywheel. The crankshaft is laid in roller bearings and reciprocates four pistons 90 degrees apart sealed by piston rings; also two spool valves 180 degrees apart which likewise are sealed by piston rings.



Crankshaft in hydraulic pump reciprocates four pistons and two spool valves

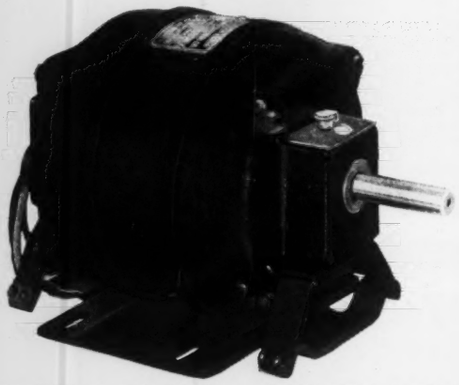
Normally the fluid is circulated through an idling valve from the crank housing which is also the reservoir. When the idling valve is in working position, the fluid is conducted through another spool valve with two outlets. This valve is controlled from a pressure regulating valve so that when fluid reaches a predetermined pressure, the valve is moved automatically and conducts fluid through the second outlet, and when the pressure in this outlet reaches a predetermined point, the idling valve is automatically moved to idling position. By the use of a flywheel, hydraulic cylinders may be operated at the same speed and economy as crank presses.

Resins Protect Brake Linings

TO COPE with the frictional heat and wear developed by the increased stopping power of brake lining, necessitated by increased speeds,

THE GARLOCK
KLOZURE
A SUPERIOR
OIL SEAL
The sealing ring in the Garlock KLOZURE is molded to exact size from an exclusive Garlock compound which is ideal for oil seal service. It is tough, durable and resilient; it is oil and heat resistant; it seals with minimum friction. Garlock KLOZURES are made in a complete range of shaft and bore sizes. Write for booklet.
THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada, Ltd., Montreal, Que.
PATENTED
TRADE
GARLOCK
MARK
GARLOCK

HOLTZER-CABOT MOTORS



QUIET—RUGGED—DEPENDABLE

Manufacturers of motor driven apparatus and appliances have found HOLTZER-CABOT Motors built to fit the job, give best results.

Our engineers have a wealth of experience. Let them shoulder your motor problems.

Write Dept. 14 for bulletin.

HOLTZER-CABOT ELECTRIC CO.
125 Amory St. Boston, Mass.
Motor Specialists for 50 Years

***For**—large volumes ··· high pressures*
—*use* Nos. 53 and 55
in supplying oil under pressure for hydraulic operations of machines.
Helical Gears and Ball Bearings insure quietness and dependability.

Write for Details
Brown & Sharpe Mfg. Co.
Providence, R. I.

B·S

Brown & Sharpe Pumps
Geared — Vane — Centrifugal

General Plastics Inc., North Tonawanda, N. Y., has developed two improved resins for incorporation in rubber linings as well as the impregnated woven type. The use of these thermosetting phenolic resin products gives greater water, oil and heat resistance to the linings and results in a more uniform coefficient of friction. The two Durez resins are known as 175 resin for use in conjunction with rubber and 1606 resin for the impregnated woven linings.

Introduces Two New Timers

SUITED particularly for short time intervals, double pole double throw, or single pole single throw, switch requirements, two new models of the "L" type timers have been introduced by Walser Automatic Timer Co., Graybar building, New York. The No. 59 timer is provided with two levers, one of which fixes the timing interval while the other simultaneously closes the switch and starts the timing mechanism. The No. 10LC is entirely new and has been developed to meet the demand for a switch-equipped single lever timer of short time range. Operation of the timer is simple, as the switch-setting and starting lever is also the time-setting lever. Timing interval depends upon the distance of the lever throw.

Instrument Measures Speeds

WITH a flashing range extending from 600 to over 12,000 flashes per minute, a new portable stroboscope has been developed by General Radio Co., 30 State street, Cambridge A, Mass., for measuring the speed of parts which it is difficult or impossible to contact with a tachometer. Speed is measured with the stroboscope

Maximum convenience of operation for stroboscope is obtained by grouping all controls on the right-hand side

Don't let inertia encumber your business

BUSINESS philosophy associates "inertia" with the ever-debatable policy of "Let well enough alone." Too often this inertia is the result of a groundless fear of upsetting routine, changing specifications and inspection standards, resetting machines, recasting work sheets, ironing out new processing kinks . . . temporarily slowing up production.

Nevertheless, executive and sales heads ever have before them the vital problems of competition and consumer preference. They see clearly the dangers of inertia. But they are not always technicians. Hence, they must look to you — metallurgist, engineer, production expert — to share the responsibility for Progress in raw material and product.

Steel — together with iron, is the basic raw material of American business. Admirable as are many of the more familiar alloying elements for giving steel this or that added quality, inertia threatens when executive, engineer and production manager are "entirely satisfied" and content to ignore the metallurgical progress still being made in alloyed steels. In fact, the past ten years have witnessed some of the greatest of all advances . . . with Molybdenum steels probably outranking all others.

"Moly" not only improves ordinary carbon steel, but actually increases other elements' effectiveness for their particular purposes. This has been proved, times beyond record, in the laboratory, foundry, factory and under every manner of punishing service conditions. Greater strength, toughness, shock resistance, less temper embrittlement, easier machinability, and many other improvements are present in Moly steels and irons. Yet, while bettering the product, Moly seldom adds to the ultimate costs — and usually reduces them.

To engineers, metallurgists and production executives we offer these interesting books: "Molybdenum in 1934" and "Molybdenum in Cast Iron — 1934 Supplement." Also ask us to mail you our periodical news-sheet, "The Moly Matrix." Be free, too, to enlist our Detroit experimental laboratory's help at any time. Climax Molybdenum Co., 500 Fifth Ave., New York.

MOLY

CLIMAX **Mo-lyb-den-um**

INDUSTRY'S MOST MODERN AND VERSATILE ALLOY

● ANOTHER JOB by CHICAGO MOLDED PRODUCTS CORP.

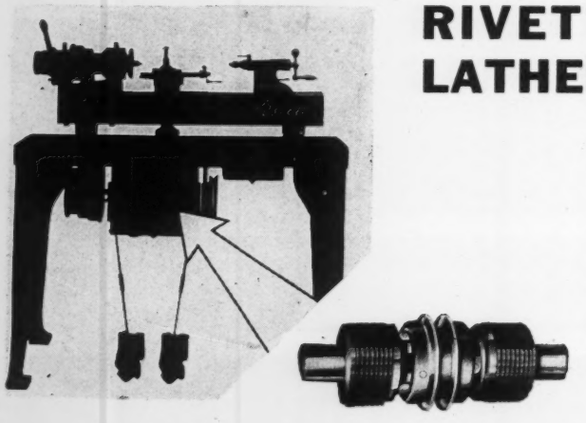
● HEARING AIDS and MOLDED PLASTICS

The light weight and perfect comfort of these Featherweight earphones contribute much to the popularity of the Trimm Group Hearing Aid. Molded plastics are used for the outer parts, because of their dielectric properties, their lightness, and their pleasant warmth in contact with the body.

Perhaps these properties of molded plastics can add to the practical value and selling appeal of your product. The Trimm Radio Manufacturing Company is only one of many nationally known firms who have availed themselves of the outstanding engineering and production facilities of this organization. You are invited to submit your problem.

CHICAGO MOLDED PRODUCTS CORP.
2147 Walnut Street Chicago, Illinois

PULLMORE CLUTCHES
USED IN SPEED BOX DRIVE OF
RIVETT LATHES



A double Pullmore Clutch is used in the speed box of the Rivett Precision Lathe as shown above. The Rivett Lathe & Grinder Co., Brighton, Mass., writes "The compactness and efficiency of this drive has been made possible through the use of your multiple disc Pullmore Clutch." Pullmore Clutches are also giving highly satisfactory results in a wide variety of other machines. These clutches are made in many sizes, single and double types, for operation in oil or dry, to transmit up to 75 H.P. at 500 r.p.m. Investigate!

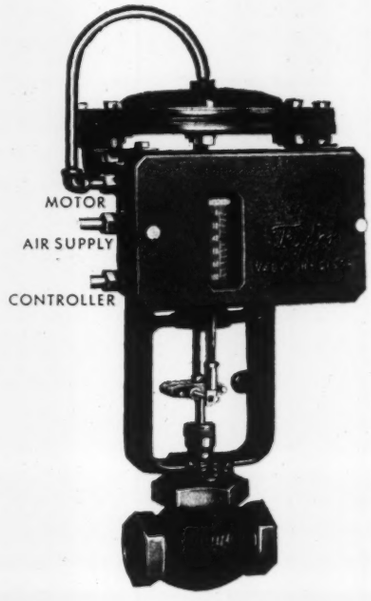
ROCKFORD DRILLING MACHINE CO.
304 Catherine Street, Rockford, Illinois
Sold by MORSE CHAIN CO., Ithaca, N. Y.
With offices in principal cities

by adjusting the flash rate until the rotating object appears stationary, and reading the flash rate off a scale which may be calibrated directly in RPM.

Setting of the trimmer adjustments so that the reed appears to stand still when the strobotac dial is set at 900 and 3600 adjust the whole calibration so that the unit is then direct reading. When the unit, shown herewith, is held before the operator so that the reflector points forward, all controls are on the right side, resulting in maximum convenience of operation. The instrument is equipped with a handle and provision is made for fastening a tripod socket to the bottom.

Assures Accurate Positioning

FOR THOSE applications where load control of a controller is not a problem, but valve-stem friction and diaphragm-motor hysteresis must be overcome to obtain precision control, Taylor Instrument Cos., Rochester, N. Y., has brought out a device which will enable more accurate positioning of the valve disk. This "Valv-Precisor" can be used with any air-operated controller and is recommended by the manufacturer for all processes which have time lags or heat capacities demanding a low or medium controller sensitivity, provided that load changes are negligible or infrequent. It is unnecessary on processes with short time lags which permit a high controller sensitivity. It should not be used on processes involving large time lags and load changes.



More accurate positioning of valve disk is enabled with new device for application to air-operated controllers

Employing a simple air system, the only

Machine-finished CHAINS FOR Pro-phy-lac-tic's *machine-finished* BRISTLES

Photo-Micrograph of
ORDINARY BRISTLE
Magnified 34 Times

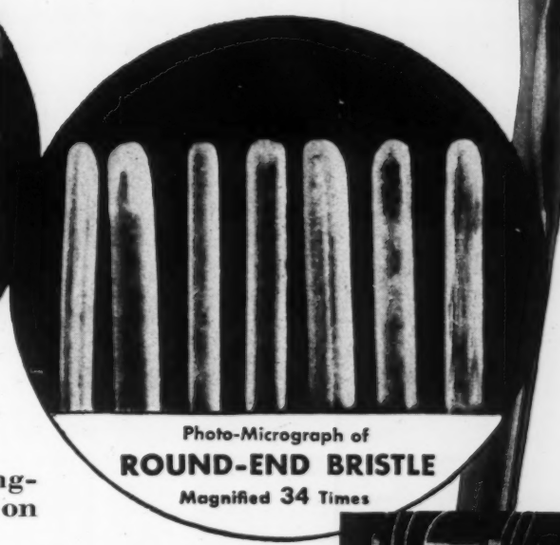
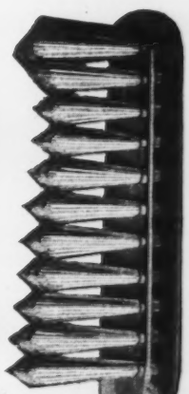


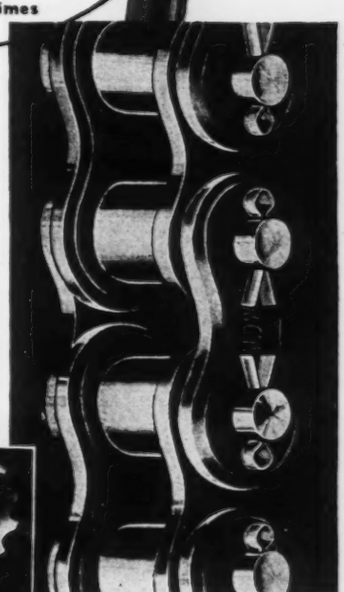
Photo-Micrograph of
ROUND-END BRISTLE
Magnified 34 Times



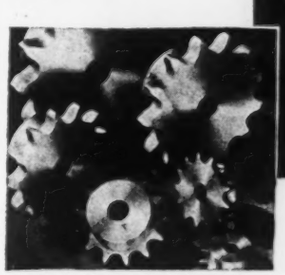
Pro-phy-lac-tic rounds off the prong-like, saw-tooth ends of each bristle on a special machine.

Smooth-operating, machine-finished Baldwin-Duckworth roller chain keeps the machinery, on which Pro-phy-lac-tic Tooth Brushes are made and packaged, operating steadily, evenly and economically.

With thousands of articles Baldwin-Duckworth machine-finished roller chain is the preferred form of drive for packaging, elevating and conveying machinery of all kinds. It's available in any pitch and in single or multiple strand, to meet all operating conditions. Fit companions for Baldwin-Duckworth Chain are Baldwin accurate-cut sprockets—equal in accuracy, finish and long life.



Send for our catalog which is not a mere listing of chains and sprockets, but a handbook of valuable technical data, tables and charts that should be on your desk. Baldwin - Duckworth Chain Corporation, Springfield, Mass.



BALDWIN—DUCKWORTH

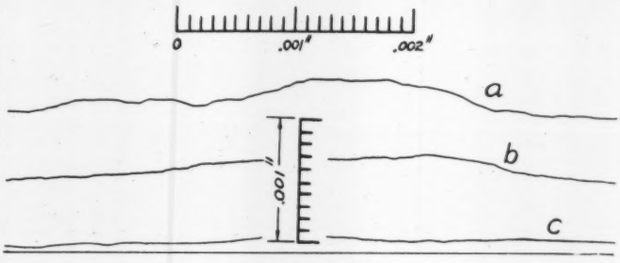
When designing a new Product -or re-designing an old one— consider using WILMINGTON FIBRE PARTS
The possible uses for Wilmington Fibre are so many and varied that the designer should be thoroughly familiar with this amazing material. It offers all the advantages of most other materials plus many that are distinctive to itself. Send for a copy of our Catalog. It tells how Wilmington Fibre is made, how it is machined into countless different parts, where and how it is used and suggests other possible uses. This catalog costs you nothing.
"Wilmington Fibre"
WILMINGTON FIBRE SPECIALTY COMPANY
PIONEERS IN FIBRE FABRICATION
WILMINGTON, DELAWARE

THE TAPERED EDGE
SEALS WITH MINIMUM FRICTION
The tapered edge of the leather washer is a vital feature of the Gits Precision Oil Seal.
The leather is so flexible at this tapered edge that only a slight pressure of the flat spring clamp ring, located at this point, is required. Friction on the shaft is therefore reduced to a minimum. Moreover this sharp tapered edge prevents the escape of oil by shearing the oil film.
Send for a descriptive folder.
GITS BROS. MFG. CO.
1861 So. Kilbourn Ave., Chicago, Ill.
GITS Precision Oil Seal

necessary adjustment to apply the device is to adapt the mechanism to the full travel of the valve stem. An indicator which shows the actual percentage of valve opening is visible through a small glass window.

Profilograph Detects Minor Surface Irregularities

FINELY ground surfaces are regularly produced to such a degree of perfection that the delicate eye and finger nail test cannot determine any irregularities. However, even these



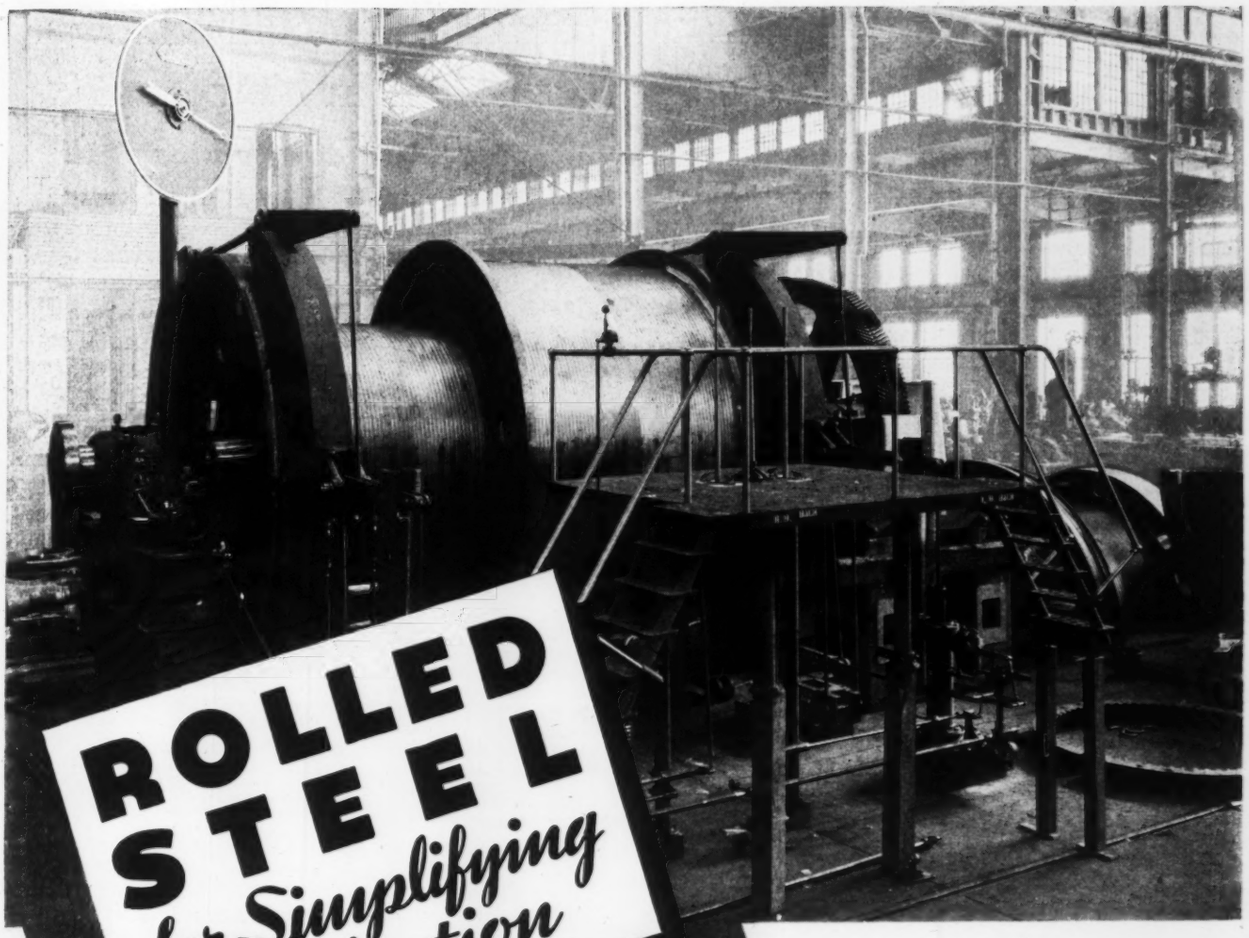
Bluntness of surface irregularities is found by precision measurement

surfaces seem to be rough when tested by the "Profilograph," the instrument now being used by Timken Roller Bearing Co. to test its new "Mirror Finish" for tapered roller bearings of its manufacture.

Has Fine Diamond Point

The instrument consists essentially of a fine diamond point which acts as a tracer or detector, moving over the surface of the specimen. To this is connected an optical system which magnifies the movement of the detector. In order to record even the most minute irregularities in the finely ground surfaces, it was necessary to apply a vertical magnification of 2000 times to the system. The trace of the detector point as magnified is photographed as a permanent record.

The accompanying illustration shows profilograms of surfaces in their true proportions, magnified 1000 times. The upper trace, *a*, shows a rough hone finish, the middle trace, *b*, a single feed mark of a diamond bore, and the lower trace, *c*, illustrates the finish secured by finish honing. Thus it will be seen that the normal irregularities of finished surfaces are essentially blunt, but when compared to the smoothness of a mirror-finished piece, even the finest work ordinarily produced seems rough.



ROLLED STEEL *for Simplifying Production*

● Here's a typical example of the way in which rolled steel irons out the kinks in a difficult manufacturing job. These mine hoist drums were fabricated entirely from rolled steel. The drums are rolled into two segments, each 180 degrees. (One of these segments may be seen at the right of the photograph.) After assembly, the grooves for the cable are machined. The larger of these drums is 12′ in diameter and will wind 5000′ of 1¾″ rope. Rolled steel provides the strength necessary for a 56,000-pound pull.

Rolled steel provides the means of simplifying many a difficult production problem. It permits greater freedom in design, greater facility in altering a product to meet special requirements.

ROLLED STEEL OFFERS THESE ADVANTAGES

1. Cheaper . . . for most parts.
2. Reduces loss due to defects or discards.
3. Permits inexpensive changes in design.
4. Faster production . . . particularly of new and unstandardized parts.
5. Reduces inventory and pattern storage.
6. Permits prompt adaptation of standard design to special requirements.
7. Eliminates excess weight.
8. Modernizes appearance.

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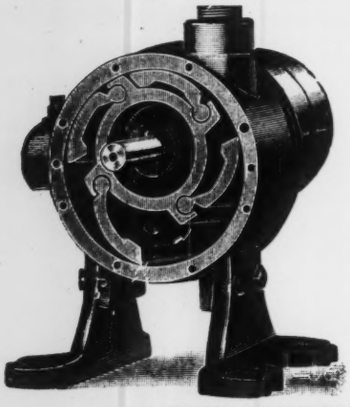
A MACHINE THAT WILL TAKE UP ITS OWN WEAR AUTOMATICALLY

will interest any Designer—



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LEIMAN BROS., NEW YORK CORP.—23 Walker St.
Makers of Good Machinery for 45 Years

Greatest Machine Show Ushers in New Era

(*Continued from Page* 31)

if space would permit. Many of the factors that have contributed to progress in machine tool development were covered in the September issue of MACHINE DESIGN, so without further discussion of the show, we will devote the remainder of these paragraphs to the machine tool congress that was an important adjunct to the exposition.

Co-operating with the National Machine Tool Builders association in this congress were the American Society of Mechanical Engineers, machine shop practice division; Society of Automotive Engineers; American Society of Tool Engineers, and the Cleveland Engineering Society.

A highspot of some of the papers more pertinent to design follow. A. W. Schneider, Heald Machine Co., discussing internal surface finishing, said that we will eventually have a measuring scale for finish similar to one of the scales for measuring hardness. Such a scale certainly is needed today in industries where one engineeer's conception of a "mirror" finish corresponds to another engineer's idea of a "rough" finish.

Guy Hubbard, machine tool consultant, pointed out that further progress in machine tool design and manufacturing technique will not be halted during the next five years, but rather will be concentrated on tool attachments and accessories more than on the basic machines themselves. Though tomorrow's machine tools are here today, he is not at all sure that the tool plant of tomorrow is with us yet. Air conditioning is destined to play a part, not only from the standpoint of comfort, but also to promote accuracy in the gaging and measuring of parts.

Noted Designer Prophecies Change

"You can not imagine a change in automobiles in the next ten years that would make the present day car look as funny to you as pictures of cars ten year ago do now, but you will see twice as much change in motor cars in the next five years as you have seen in the last ten," William B. Stout declared. The same goes for machine tools; the same for airplanes, and practically everything we are doing, he continued. And we will have new lighting systems, new types of home equipment, new layouts of cities, new methods of transportation, and many other things that we haven't dreamed of yet.

Now that the machine tool show is over, thoughts turn to the effect this tremendous number of new, high production machines will have on our economic and social life. Mr. Stout gives an indication of what we may expect, in the few words above.

Avoid Waste of Material in Parts Design!

(*Concluded from Page* 28)

By expression (44)

$$S_a/S'_m = (63{,}950 - 21{,}300)/(63{,}950 + 21{,}300) = 0.5$$

An inclined line drawn in *Fig.* 29, as was done in *Fig.* 27, intersects the upper stress line on the elastic limit and gives $S_a = 17{,}100$ pounds per square inch.

The stress concentration effect of the threads, taken into account by *Fig.* 20, (M. D., Aug. p. 28) curve *d*, for $S_u = 92{,}500$ pounds per square inch is expressed by $e_{sr} = 0.74$. The necessary area, by expression (42), taking $f = 1.5$ and $k_r = 1$, since the thread effect is taken as surface effect,

$$A = (63{,}950 - 21{,}300) \times 1.5/(2 \times 0.895 \times 0.74 \times 17{,}100) = 2.83 \text{ sq. in.}$$

and the minimum root diameter

$$d = \sqrt{2.83/0.7854} = 1.898 \text{ in.}$$

which gives the same outside diameter, as found by preliminary calculations, $d_1 = 2\frac{1}{4}$ inches.

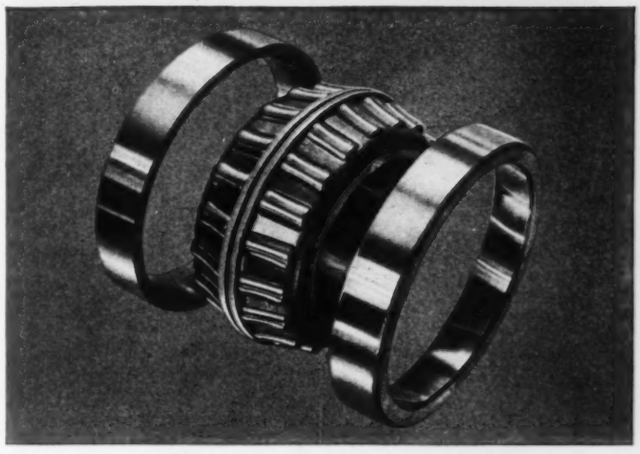
The foregoing discussion, also covered in the June, July and August issues of MACHINE DESIGN, gives briefly the latest developments in the determination of stresses and data for their application to design problems. Taking into account these data makes the design procedures somewhat longer but not more complicated, as can be seen from the examples, at the same time it allows to reduce considerably the apparent margin of safety and to increase the assurance that the parts when properly designed will not fail through some mysterious behavior.

The problems of static loading are but little affected by a more accurate approach. Impact loading so far seems to have been a stumbling stone for machine designers and builders. Since impact occurs in all mechanism due to running clearances and since the inertia loads increase with speed, a more accurate evaluation of the various factors is particularly important and can be easily done keeping in mind the concept of resilience. Finally, the nightmare of high-speed machinery, the so dreaded fatigue failure, can be practically crowded out from the picture by using a new approach, so far as practical design is concerned, namely the endurance diagram.

The author realizes that the problem of rationalizing machine design procedures is a very difficult one and cannot be solved by a single individual. These articles are only the first step. He believes that other designers should come out with a frank discussion of the methods which he advocates and make suggestions as to how to improve the procedure further.

THE END

These 3 Features mean *better* Bearing Performance...



The exclusive Shafer CONCAVE roller design combines—in a single bearing—

1 Roller bearing capacity for any combination of radial-thrust loads.

2 Free-rolling self-alignment within the bearing itself, without extra bulk or added weight.

3 Simple adjustability.

This combination delivers an extra power saving, an extra margin of capacity and reliability, with simpler installation and greater adaptability. These outstanding features, with provision for simple adjustment, mean long bearing life at high efficiency.

Catalog 12 gives complete data on Radial-thrust Roller Bearings, Pillow Blocks, Hanger Boxes, Flange Units, Take-up Units, Cartridge Units, Duplex Units, Conveyor Rolls.

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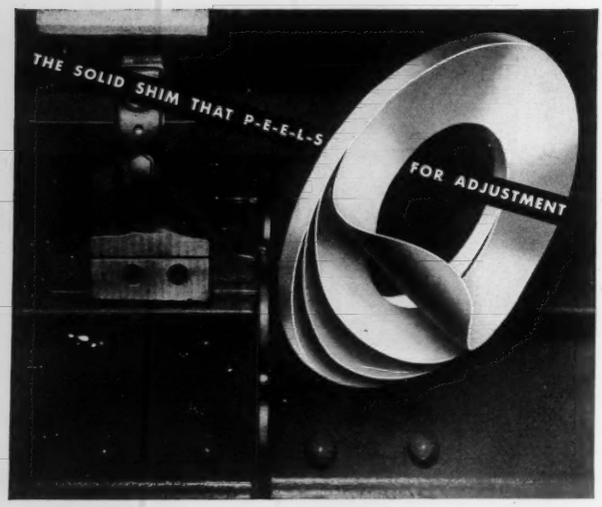

Assembled Units of Improved Automatic Spooler—Barber-Colman Company.

quick assembly spacing

For precision spacing of bed sections to fit the drum units, Barber-Colman utilizes Laminum shims. Quick; accurate . . . lower assembly cost. You simply p-e-e-l one or more laminations at a time from the brass shim. Write for sample.

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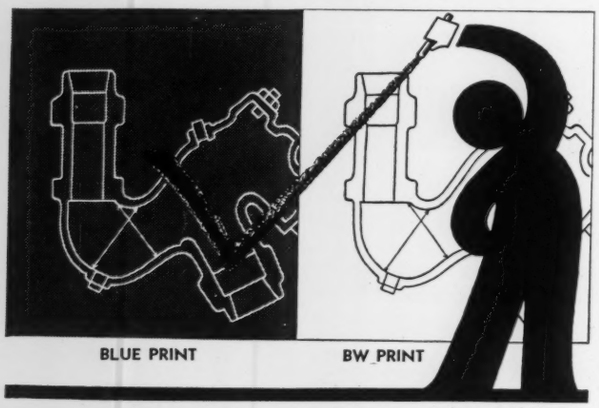

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Sometimes an important note, made on the *blue* background of a blue print, is as hard to find as a needle in a haystack. The result may be disastrous. Why run this risk—when BLACK AND WHITE Prints give you *white* backgrounds to mark on? BW Prints are true black-line prints, made by a simple, instantaneous semi-dry process from paper or cloth exposed in your own blue print machine. Production is FASTER than that of blue prints—and BW Prints are more useful in every way. Complete information is yours for the asking!

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SENSITIZED PAPERS . . . REPRODUCTION PROCESSES . . . DRAFTING ROOM EQUIPMENT . . . DRAWING MATERIAL

Professional Viewpoints

(*Concluded from Page* 46)

corrects such a condition when the return run of chain leaves the sprocket in a direction parallel to the oncoming run, and has an angle of wrap of 180 degrees. In other words, to insure the smoothest action the angle of wrap between the two chains should be a multiple of the angle subtended by two adjacent teeth of the sprocket.

This is true even on idlers and when no compensating device is used. In correct elevator and conveyor practice, an even number of teeth is used in sprockets when the chains are parallel and a multiple of 4 is used when the leaving chain is at 90 degrees with the oncoming chain.

This insures any pulsations being in step all around the course of the chain as the leaving chain always will be at the same speed as the oncoming chain.

—W. E. HALE, Chief Engineer,
Beaumont Birch Co.

Directory Is in Constant Use

To the Editor:

ABOUT two years ago the writer received one of MACHINE DESIGN's directories of alloys. Through constant use the book has become rather dog-eared and we should like to inquire whether there has been a subsequent issue and, if so, whether we might be favored with a copy of it.

—J. D. ZAISER,
Ampco Metal Inc.

EDITOR'S NOTE—The fourth edition of MACHINE DESIGN's directory of iron, steel and nonferrous alloys will be published early in 1936. Material is now being collected for this directory.

Redesigning for Appearance

To the Editor:

I HAVE followed the articles in your magazine with a great deal of interest, especially those dealing with design for appearance. I think that your attitude toward redesign and styling is a very commendable one. You seek at all times to reduce the sensational element and your emphasis on the integration of new materials, new methods, and engineering ingenuity in this movement to clean up our machines has done a great deal to place the industrial artist in a position favorable to his making a permanent contribution to the industry.

—ENGINEER

MANUFACTURERS' PUBLICATIONS

ALLOYS (STEEL) — An unusually attractive and well prepared book has just been published by Bethlehem Steel Co., Bethlehem, Pa., on alloy and special steels in the form of bars, billets, blooms and slabs. The handbook gives working data on properties and performance, and brings all pertinent existing data on these alloy steels up to date in one complete volume. Color charts of heat colors and temper colors, 140 pages of tables and useful information, and photomicrographs of various compositions are given in the 375-page book.

ALLOYS (STEEL)—Inland Steel Co., Chicago, has prepared a folder on copper alloy steels and their uses to combat corrosion.

BEARINGS—Timken Roller Bearing Co., Canton, O., has prepared a booklet on the new mirror finish which is being given to the bearings manufactured by the company. Complete details of the finish and its effect on bearing performance are presented.

BEARINGS — Norma-Hoffmann Bearings Corp., Stamford, Conn., has prepared a bulletin giving engineering data on its line of precision needle roller bearings. Typical applications are presented, as well as information necessary when considering the application of these compact bearings to all types of machinery.

BEARINGS — Catalog No. 12 of Gwilliam Co., Brooklyn, N. Y., gives a complete presentation of the sizes and load capacities of the ball and roller bearings manufactured by the company. Included in the presentation are a number of designs of thrust bearings for widely varying applications.

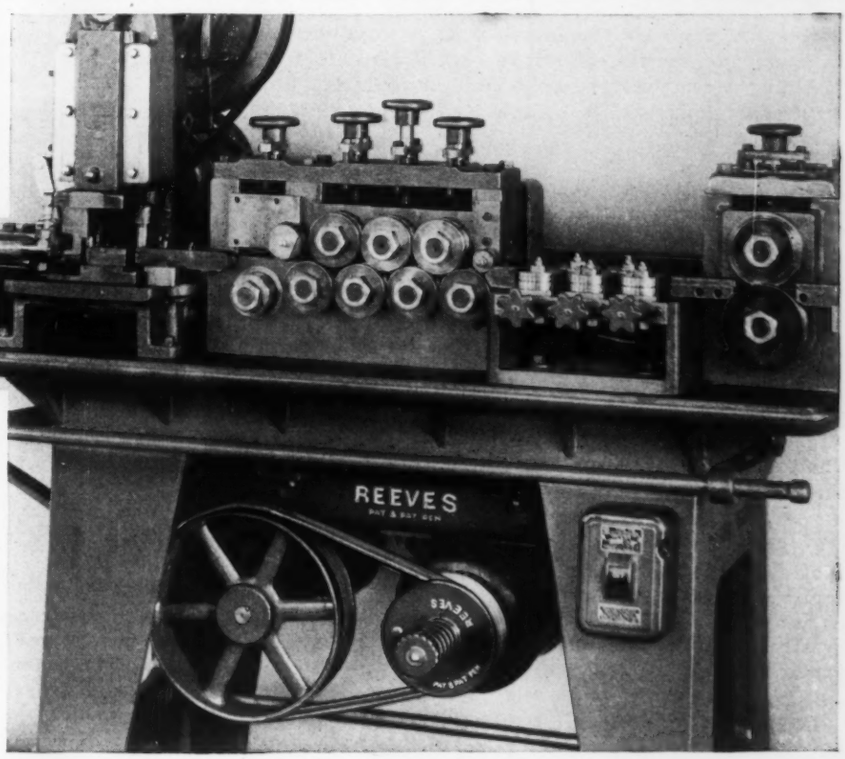
BIMETALS — A comprehensive review of specifications, properties and methods of application of modern thermostatic bimetals is presented in a recent publication of H. A. Wilson Co., Newark, N. J. Ten full-page charts show deflection and force characteristics, along with appropriate design formulas.

BRONZE — Data on the uses and properties of various bronze alloys have been collected and published by Joseph T. Ryerson & Son Inc., Chicago, as part of its new 26-page booklet on Permite six foot cast bronze bars. Subjects covered include wear resistance, coefficient of friction, machinability, tensile strength and hardness of many alloys.

CLUTCHES—Conway Clutch Co., Cincinnati, has prepared bulletin XYZ on its new line of small clutches for restricted swing radii and for fractional horsepower motors.

COMPOSITION MATERIALS—Koroseal, a synthetic rubber-like material made in a variety of compounds ranging from bone-like hardness to a liquid, is presented in a bulletin of B. F. Goodrich Co., Akron, O. Complete engi-

★ REEVES ★
VARI-SPEED
MOTOR PULLEY



The Efficient, Simplified Speed Control Unit for Direct Installation on Standard Motor Shaft

To builders of light h. p. machines, the REEVES Vari-Speed Motor Pulley offers many advantages. Exceedingly compact and adaptable. Provides infinite speed adjustability over 3:1 range. Any desired speed on driven machine made instantly available at turn of handwheel. Forms actual driving element between motor and driven shaft. Original position of motor need not be changed. Use either flat faced or sheave pulley on driven shaft. Handwheel control may be extended to any desired position. Made in seven sizes—from fractional to 7½ H. P.

Illustration of standard equipment application on Straightening and Cut-off Machine used to cut accurate lengths for continuous feeding of coiled metal stock of different weights. Note compactness of this modern speed-control unit.

REEVES PULLEY COMPANY, COLUMBUS, IND.
Without obligation, send copy of Catalog H-300.
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neering details, and the properties of the material are included.

CONTROLS (ELECTRICAL) — Walser Automatic Timer Co., New York, has prepared a folder on timers adjustable to any timing range within the maximum.

CONTROLS (ELECTRICAL) — Time switches which will control almost any electric circuit on a schedule related to the time of day are presented in a recent bulletin, GEA-1427D, of General Electric Co., Schenectady, N. Y.

COUPLINGS—Free lateral float of the connected shafts is provided by the Uniflex coupling described in a bulletin of Alloy Products Corp., Waukesha, Wis. A complete description of the coupling, dimensions and ratings are given.

COUPLINGS — Important changes which have recently been made in the Francke flexible couplings are presented in an attractive new publication of John Waldron Corp., New Brunswick, N. J. The bulletin gives directions for size selection and coupling service factors.

DESIGN DEPARTMENT — Ozalid white prints, prepared by a direct printing, dry developing process, how these prints can be made, and the developing machines are covered in a series of publications issued by Ozalid Corp., New York. The finished prints are black line on white, or colored lines on white or colored stock.

DRIVES—Details on new double reduction units for use on vertical drives are given in a recent publication of Winfield H. Smith Inc., Springfield, Erie County, N. Y.

DRIVES — A new infinitely variable speed transmission which combines the functions of a speed variator, an automatic centrifugal clutch and a dynamic brake, providing a complete reversing cycle of operation where required, is announced in bulletin No. 600 of Falk Corp., Milwaukee.

DRIVES — Details of the construction of Condor compensated belting are described and explained in bulletin No. 6808-B of Manhattan Rubber Mfg. Division, Passaic, N. J. Condor belting embodies two new principles in flat belt design. V-belts manufactured by the company are completely presented in bulletin No. 6840.

DRIVES—Endless transmission belting, descriptions, specifications, and sectional and installation views of the product, are presented in a bulletin of Manhattan Rubber Mfg. Division of Raybestos-Manhattan Inc., Passaic, N. J. The bulletin contains technical data on how to determine the length of the endless belts, and horsepower tables.

DRIVES — Link-Belt Co., Philadelphia, has prepared booklet No. 1574 which gives the new combinations and capacity ranges available in P. I. V. gear variable speed transmissions. The range and combinations have been greatly increased to give wider range and flexibility of application.

DRIVES — Authoritative information on modern methods of variable speed regulation for industrial machines of all types is given in a very well prepared, 112-page book of Reeves Pulley Co., Columbus, Ind. Included are data on the use of the transmission by machine designers as standard equipment, illustrated applications of the unit in specific industries, practical engineering information with dimension drawings and tables that enable the manufacturer to plan his own applications, and many other points of value when considering the application of infinitely variable speed transmissions and motor pulleys.

ELECTRONIC EQUIPMENT — An indexed bibliography regarding high vacuum and gas-filled tubes in industry has been published by General Electric Co., Schenectady, N. Y.

FASTENINGS—Structural rib bolts of a new design, provided with automatic lock nuts are presented in a folder of Automatic Nut Co., New York.

MOTORS — General Electric Co., Schenectady, N. Y., has prepared bulletin GEA-2177 on its line of Selsyn motors for maintaining machines in synchronism and for assuring safe operation. Applications of the motors are illustrated.

PLASTIC MATERIALS — Dilecto, a laminated phenolic material, is presented in complete detail in an attractive publication of Continental-Diamond Fibre Co., Newark, Del. Typical applications, machining, physical and chemical properties, and other points of interest to engineers are included.

SHAPES — Union Drawn Steel Co., Massillon, O., has issued a bulletin on screw machine stock expressly made for automatic operations.

STEEL (ALLOY-CLAD) — Latrobe Electric Steel Co., New York, is distributing a bulletin on its line of Duo-Metals which are available in high speed and alloy tool steels as well as stainless alloys. The special steels are joined to any class of backing ferrous metals by a new process.

TIRES—How to select the right tire for the particular job; how to handle changeovers in design from steel wheels to rubber tired equipment; and a discussion of the four types of rubber compounds which meet the tire demands of industrial users in many and varied services are given in a booklet of B. F. Goodrich Co., Akron, O.

WELDED PARTS AND EQUIPMENT — American Manganese Steel Co., Chicago Heights, Ill., is distributing a folder giving complete details on its line of hard-facing welding rods for protecting machine parts against wear and abrasion.

WELDED PARTS AND EQUIPMENT—Details on the welding possible with the new machines manufactured by Hobart Bros. Co., Troy, O., are given in a recent publication of the company which includes illustrations of welding design fabricated by the machines.

WELDED PARTS AND EQUIPMENT—Welding elecrodes, their metallic composition, physical properties, aplications, general description and welding procedure form the basis for a new catalog issued by Wilson Welder & Metals Co., North Bergen, N. J.

WIRE CLOTH — Space, mesh and flexible wire cloth in a number of different weaves and materials is presented in catalogs No. 40 and 42 of Audubon Wire Cloth Corp., Philadelphia. The catalogs include products for all possible types of service to which this cloth might be applied.

Business and Sales Briefs

DANLY MACHINE SPECIALTIES INC., 2110 South Fifty-second avenue, Chicago, representative to the mechanical industries of Danly-Smithwelding, has opened an assembly plant and branch office at 3913 North Broad street, Philadelphia. S. R. Anstey is in charge of the Philadelphia Branch office plant.

* * *

The Industrial division of S. S. White Dental Mfg. Co., handling all industrial products manufactured by the company, has moved to the twenty-third floor, 10 East Fortieth street, New York. George T. Latimer is manager of the division.

* * *

The Philadelphia sales office of Ajax Flexible Coupling Co., Westfield, N. Y., has been moved to 1108 Otis building. V. L. Sanderson is representative in charge.

* * *

Clark Controller Co., Cleveland, has appointed Harris-Green Co., Farmers Bank building, Pittsburgh, as sales-engineering representatives. The Pittsburgh branch office of the Clark company will be maintained as at present.

* * *

J. D. Benfield and Robert Turrell, formerly with the Electrical Division of Steel & Tubes Inc., have formed their own organization, known as Turrell & Benfield Inc., with headquarters at Detroit, and are representing Electrunite Steeltubes and Fretz-Moon conduit products in the Michigan territory.

* * *

A union of the business of Inland Steel Co. with that of Joseph T. Ryerson & Son Inc., has been approved by a stockholders' meeting of the Inland company.

* * *

Aluminum Industries Inc., Cincinnati, manufacturer of Fermite products has opened a new office, in suite 1004, Petroleum building, 616 South Michigan avenue, Chicago. R. L. Corey is district sales manager for the states of Indiana, Illinois, Wisconsin, Iowa, Missouri and Minnesota. N. R. Patterson will also have his headquarters in the Chicago office.

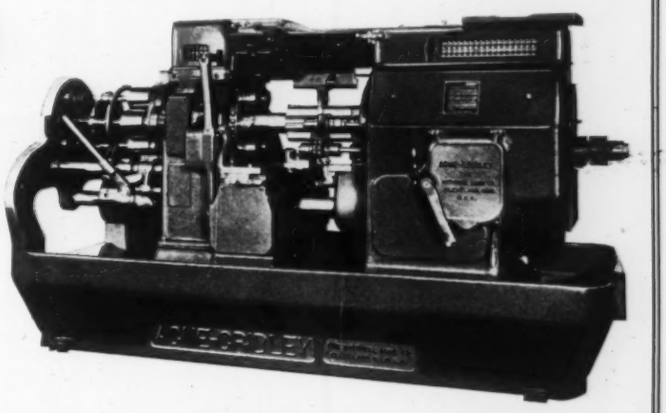
* * *

An exchange of stock between Bantam Ball Bearing Co., South Bend, Ind., and Torrington Co., Torrington, Conn., has been approved by stockholders of the company. The Bantam company will continue operations as heretofore, but as a subsidiary of the Torrington company. K. L. Herrmann, general manager of Bantam, will continue to act in that capacity.

* * *

Officers recently elected by Summerill Tubing Co., Bridgeport, Pa., include the following: E. L. Parker continues as president, a position he also holds with Columbia Steel & Shafting Co. and Edgar T. Ward's Sons Co. of Pittsburgh; J. B. Boore, formerly acting as assistant to

The National Machine Tool Show
AUTOMATIC LUBRICATION



The recent National Machine Tool Show at Cleveland revealed a universal adoption of automatic lubrication on new designs,—from this showing it is evident that the modern machine tool requires automatic lubrication.

Blanchard Pulsolator lends itself to the designer's requirements and enables him to modernize his machines for better bearing performance, safer operation, lower maintenance and continuous service. One pumping unit can lubricate up to 100 bearings through sight or enclosed feeders with adjustable or set positive feeds. The equipment can be built in as an integral part of the machine.

Our engineers will assist designers to incorporate Pulsolator on their new machines or plan installations on existing plant machinery. Write for our descriptive bulletin B-10.

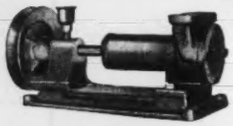
Five National Acme automatic screw machines demonstrated the use of Pulsolator on modern production equipment. Sight feeders visible in windows in the frames of the machines give proof of every bearings proper lubrication.

RIVETT LATHE & GRINDER INC., BRIGHTON, BOSTON, MASS.

BLANCHARD PULSOLATOR

AUTOMATIC OIL LUBRICATION SYSTEM

VIKING

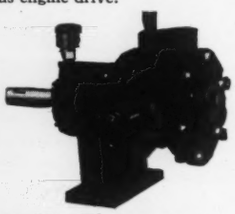


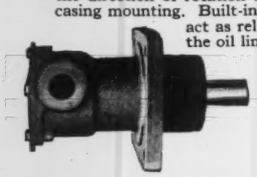
Viking Standard Pumps

For handling any grit-free liquid of any viscosity from water to molasses . . . with efficiency and economy . . . use the Viking Rotary Pump, "Just Two Moving Parts". Capacities from 1/5 to 1,050 G.P.M. Electric motor, belt or gas engine drive.

Coolant Pumps

For machine tool cooling purposes use the Viking Coolant Pump. Capacities of 5, 10, 15, 20 and 35 G.P.M. Ports are tapped and plugged to permit changing the direction of rotation . . . 4 position casing mounting. Built-in relief rotor to act as relief valve when the oil line is shut off.





Hydraulic Pressure

For the actuation of machine tool movements and the operation of hydraulic lifts and elevators use the Viking Hydraulic Oil Pump. Made of laboratory-tested metals in capacities of 5 to 45 G.P.M.

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Cedar Falls, Iowa

Rotary PUMPS

WRITE FOR IT . . .

It gives you in one handy file, a set of samples of the many types of felt . . . together with chart showing applications of each type and grade. Standard file size . . . developed to be useful to you; not to sell you. We'll gladly mail you one no matter what felt you use.

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Booth
PRECISION CUT FELT

593

INDEX TO ADVERTISERS

Ahlberg Bearing Co.	*
Alemite Corp.	61
Allen-Bradley Co.	Inside Back Cover
Allis-Chalmers Mfg. Co.	59
American Gear Manufacturers' Association	*
American Steel & Wire Co.	12
Baldor Electric Co.	*
Baldwin-Duckworth Chain Corp.	71
Bantam Ball Bearing Co.	*
Bethlehem Steel Co.	56
Bodine Electric Co.	62
Booth Felt Co.	80
Brown & Sharpe Mfg. Co.	68
Bruning, Charles, Co., Inc.	76
Bunting Brass & Bronze Co.	*
Carboloy Co., Inc.	*
Century Electric Co.	10
Chain Belt Co.	*
Cleveland Worm & Gear Co.	9
Chicago Molded Products Corp.	70
Chicago Rawhide Mfg. Co.	4
Climax Molybdenum Co.	69
Cutler-Hammer, Inc.	Inside Front Cover
Danly Machine Specialties, Inc.	*
Diamond Chain & Mfg. Co.	13
Diehl Manufacturing Co.	*
Dietzgen, Eugene, Co.	57
Dings Magnetic Separator Co.	*
Dumore Co.	64
Emerson Electric Co.	*
Fafnir Bearing Co.	*
Fairbanks, Morse & Co.	82
Formica Insulation Co.	14
Garlock Packing Co.	67
General Electric Co.	11, 15
Gits Bros. Mfg. Co.	72
Graton & Knight Co.	*
Hamilton Manufacturing Co.	74
Hanna Engineering Works	3
Hills-McCanna Co.	*
Holtzer-Cabot Electric Co.	68
Howell Electric Motors Co.	*
Hyatt Roller Bearing Co.	*
Illinois Steel Co.	73
Imperial Electric Co.	*
International Nickel Co.	65
Kropp Forge Co.	*
Laminated Shim Co., Inc.	76
Leiman Bros., Inc.	74
Lincoln Electric Co.	*
Linde Air Products Co.	8
Link-Belt Co.	*
Lovejoy Tool Works	*
Marlin-Rockwell Corp.	53
Master Electric Co.	58
Michigan Leather Packing Co.	60
Michigan Tool Co.	63
New Departure Manufacturing Co.	6
New Jersey Zinc Co.	*
Norma-Hoffmann Bearings Corp.	55
Ohio Forge & Machine Corp.	*
Reeves Pulley Co.	17, 77
Rivett Lathe & Grinder Corp.	79
Rockford Drilling Machine Co.	70
Roper, Geo. D., Corp.	*
Shafer Bearing Corp.	75
Shakeproof Lock Washer Co.	*
S K F Industries, Inc.	*
Summerill Tubing Co.	18
Timken Roller Bearing Co.	Back Cover
Twin Disc Clutch Co.	*
Union Carbide & Carbon Corp.	8
Vickers, Inc.	*
Viking Pump Co.	80
Wagner Electric Corp.	*
Wilmington Fibre Specialty Co.	72
Wright, L. G., Inc.	*

*Advertisements appear in previous issues.

the president, is now vice president; George P. Kraemer, secretary and treasurer; N. H. Wolf continues as general manager; H. M. Brightman, located at Pittsburgh continues as assistant to the president.

* * *

Republic Steel Corp., Youngstown, O., has opened a new sales office at 622 Dwight building, Kansas City, Mo., in charge of Robert L. Pierce of the St. Louis District sales office. John W. Carpenter, for sixteen years district sales manager in the Cleveland territory for Otis Steel Co., has joined the Republic organization as assistant manager of sales, sheet and strip division. J. P. Distler has been appointed manager of sales, wire division, for the company, with headquarters at the Grand Crossing plant in Chicago.

* * *

A new sales district consisting of the states of North and South Carolina, Virginia, Maryland, Delaware, southern New Jersey including Trenton, and southeastern Pennsylvania has been formed by Steel & Tubes Inc., Cleveland. C. J. Boyd is district manager. J. F. Keeler, formerly of the sales promotion department in Cleveland, has been transferred to the Brooklyn office of the company to head sales promotion work in the east. I. H. Anderson, formerly of the Philadelphia office, has been transferred to the Brooklyn office and J. S. Anderson, formerly of the Detroit office has been transferred to the new Philadelphia office.

CROSS SECTIONS

NO SUPERLATIVES in the English language can adequately express the greatness of the Machine Tool show. If you missed it, hurry around to everyone you know who was there and pick up all the information you can garner. There has never before been so many excellent designs on display at one time, many of these designs are described on page 30.

GOING from booth to booth, one could not help but be impressed by the added efficiency that built-in lighting gives to a machine. The show was lighted probably better than the average shop yet in some displays the operating parts, tools and work were hard to see, while in others they stood out distinctly. Built-in lighting will soon be a necessary feature; better start planning it now.

ONE OF the features of the Machine Tool show was a number of historic machine tools. They were labeled as museum pieces. Judging by the new machines, the great majority of machine tools now in use in plants should also be labeled museum pieces. Design is moving so quickly that anything in use much over a year is now almost antique.

A COMPARATIVELY minor point in design which demonstrated its importance at the show is nameplates. Good ones, conveniently located, gave the story of the machine or part of the machine to everyone who happened along. Poor nameplates, poorly located were frequently passed over. Nameplates are a detail that the designer should not overlook.

IF APPRENTICES generally were like those intelligent fellows operating the machines at the show, the designer would not have to worry about the operator not being able to utilize his designs correctly. Unfortunately, they are not, so careful design planned to secure simple operation is still in order.

SIXTY-FIVE per cent of the money paid by industry for machinery and equipment goes to labor, according to recent data collected by the National Industrial Conference Board. Maybe machinery isn't such an ogre after all. On this basis labor will receive about four million from sales made from the floor of the Machine Tool show!

PHILOSOPHERS claim that youthful troubles acquire a romatic tinge after the passing of the years, but we know of a couple of designers that have done something to eliminate those troubles. No doubt remembering many hours of hard labor spent as a boy in producing a small dish of salty ice cream, these designers have developed a home ice cream freezer which works while you sit at your ease. The unit fits into the freezing chamber of an electric refrigerator, doing away with the necessity of handling crushed ice, salt, water, etc. A motor drive eliminates the drudgery of turning the hand crank.

ANYONE who cannot think of a method of solving the problem of securing a certain motion or cannot conceive of any new machine that might be needed would do well to study nature, and to watch his fellows, thus determining just what they dislike and just what they need. All of the ancient inventors received the impetus for their ideas of motion wholly from natural phenomena. An observant man watching a fellow train passenger vainly attempting to buy cigarettes in a hurry at a way station, designed the cigarette vending machine.

THIS hasn't a great deal to do with machines, but the idea back of it, that is, studying conditions of use, can well be applied to every machine built. We often wonder why the vast majority of makers of bath tubs and showers place their faucets in such inconvenient positions. You can't lie in the tub and let the water run in without performing gymnastics to adjust it, and the controls for the shower invariably require that one stand in the too hot or too cold water to get the right proportions. Couldn't these faucets be placed to one side where they could be reached easily—at negligibly more cost?

THERE are several indications of business temperament that never are transferred to charted curves, but with them one can sense the growing appreciation of the upward trend and increased confidence. One of these is the enormous shifting of men in sales offices, additions, opening of new offices, etc., which has been going on quietly. The lines are being strengthened for coming business. Another is the increased quality in manufacturers' publications. The Bethlehem and Reeves bulletins announced on page 77 are examples of how more money is being spent. And a third is the fine demonstrations manufacturers are giving in announcing new parts or machines to editors of technical papers. Perhaps we should add that these are more especially appreciated because they usually are accompanied by luncheon, and we eat again!